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Interim Bioventing Pilot Test Results Report for Table 3.5 - when taken Spill Site No. 1, Building 457 Area, and USt 702

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Eaker Air Force Base Blytheville, Arkansas

Prepared For

Air Force Center for Environmental Excellence Technology Transfer Division Brooks Air Force Base San Antonio, Texas

and

Air Force Base Conversion Agency/OL-J Eaker Air Force Base, Arkansas

August 1996



AQ MOI- 02-0226

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INTERIM BIOVENTING PILOT TEST RESULTS REPORT FOR SPILL SITE NO. 1, BUILDING 457 AREA, AND UST 702

EAKER AIR FORCE BASE BLYTHEVILLE, ARKANSAS

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE BROOKS AFB, TEXAS

and

AIR FORCE BASE CONVERSION AGENCY/OL-J EAKER AFB, ARKANSAS

Prepared by:

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August 1996

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INTERIM PILOT TEST RESULTS REPORT FOR SPILL SITE NO. 1, BUILDING 457 AREA, AND UST 702 EAKER AFB, ARKANSAS

1.0 INTRODUCTION

An initial bioventing pilot test was performed by Parsons Engineering Science, Inc. (Parsons ES) [formerly Engineering-Science, Inc. (ES)] at Spill Site No. 1 (SS1), Building 457 Area (B457 Area), and Underground Storage Tank (UST) 702 at Eaker Air Force Base (AFB), Arkansas during the period from March 18 through April 5, 1996. The proposed scope of work for these three sites was performed for Eaker Air Force Base Conversion Agency (AFBCA) and the Air Force Center for Environmental Excellence (AFCEE) Technology Transfer Division (ERT) under contract F41624-92-D-8036, Order 0017. The purpose of this report is to describe the results of the initial pilot tests at each site and to make specific recommendations for extended testing to determine the long-term impact of bioventing on site contaminants. Descriptions of the history, geology, and contamination at the three sites are contained in the Bioventing Pilot Test Work Plan (Parsons ES, 1996). The location of each site with respect to the base is shown in Figure 1.1.

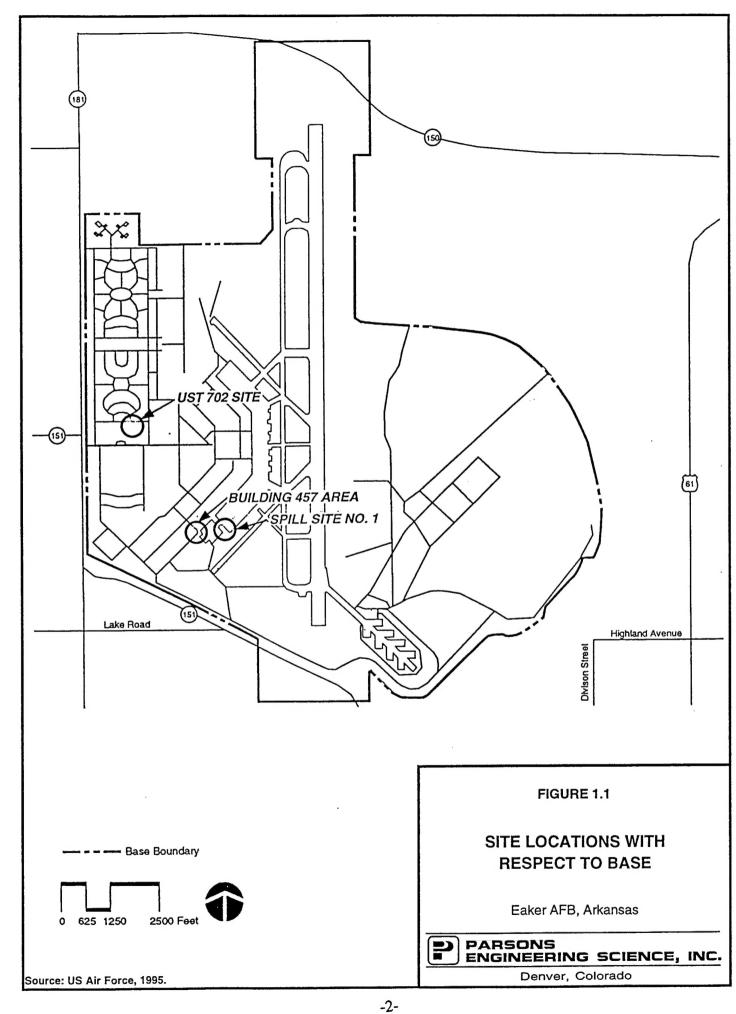
2.0 PILOT TEST RESULTS - SPILL SITE NO. 1

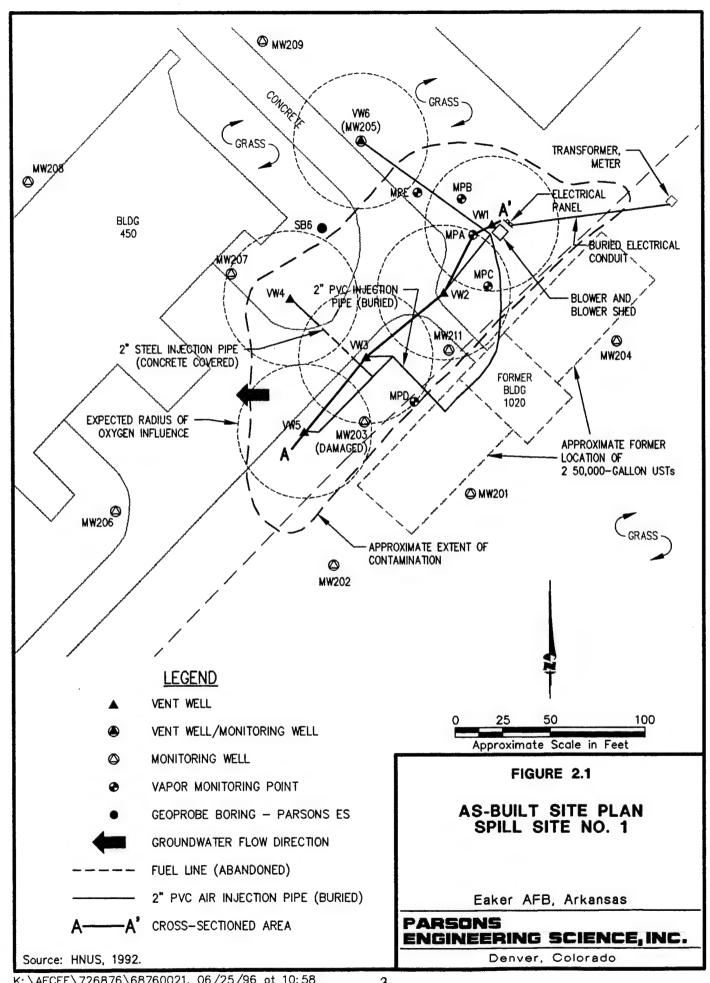
The source of contamination at this site was four 50,000-gallon USTs that formerly were used to store Jet-A fuel (Halliburton NUS [HNUS, 1994]). The tanks, along with a portion of grossly contaminated soils, have been removed.

2.1 Pilot Test Design and Construction

An initial bioventing pilot test was performed by Parsons ES at SS1 during the period from March 18 through April 5, 1996. A total of nine Geoprobe® boreholes were drilled at the site to better define the extent of the contamination, and to determine appropriate vapor monitoring point (MP) screen depths and optimal vent well (VW) placement. Installation of five vapor monitoring points (MPs) took place on March 20, 27, and April 4, 1996. The MPs were installed by Parsons ES in Geoprobe® boreholes. Installation of five air injection VWs took place on March 22 and 23, 1996, following MP installation and exploratory Geoprobe® drilling. The VWs were installed prior to pilot testing, and were sited based on an expected radius of oxygen influence of 30 feet. Drilling services were provided by Anderson Engineering Consultants, Inc. of Little Rock, Arkansas, and well installation and soil sampling was directed by Mr. David Teets, the Parsons ES site manager. Electrical services were provided by Cache Valley Electric of Blytheville, Arkansas.

Five VWs (VW1 through VW5), five MPs (MPA through MPE), and a blower unit were installed at SS1. Existing well MW205 also was used as a VW, and wells MW203, MW207, and MW209 were used as MPs. Figure 2.1 is a site layout showing the locations of the six VWs, eight MPs, blower unit, and other existing groundwater monitoring wells at the site. The hydrogeology of the site is depicted on the cross-





section on Figure 2.2. Boring logs for the Geoprobe® boreholes, MPs, and VWs are included in Appendix A. The background MP for this site was the existing groundwater monitoring well MW10, which is screened several feet above the groundwater surface. The following sections describe the final design and installation of the bioventing system at SS1.

2.1.1 Air Injection Vent Wells

The air injection VWs were installed in highly contaminated soils northwest of former Pumphouse No. 4 (Building 1020). The VWs were constructed using 4-inch-diameter, schedule 40 polyvinyl chloride (PVC) casing and slotted PVC screen. Table 2.1 summarizes the VW construction details. Vent wells VW3, VW4, and VW5 were constructed with two types of slotted screen to facilitate air flow through the less permeable clay layer. A bentonite seal was placed between each slotted screen type at a depth corresponding to the blank casing at the pipe joint. The top of each VW was completed with a 12-inch-diameter, flush-mounted well box mounted in a rectangular concrete pad. Details of the six VW constructions are presented on Figures 2.3 through 2.8.

2.1.2 Monitoring Points

The MP screens were installed at the depths listed on Table 2.1. The five new MPs (MPA, MPB, MPC, MPD, and MPE) at this site were constructed as shown in Figure 2.9. Each MP, installed in Geoprobe® borings, was constructed with a 6-inch-long, 0.25-inch, outside-diameter (OD) stainless steel screen implant attached to 0.5-inch-OD, high-density polyethylene (HDPE) tubing that extends to the ground surface. The top of each 0.5-inch HDPE riser was completed with a 3/8-inch needle valve. The top of each MP was completed with a flush-mounted metal well protector set in concrete.

The existing groundwater monitoring well MW10, was used as the background MP for this pilot test. MW10 is located in an uncontaminated area approximately 1,200 feet southwest of SS1 and has a screened interval extending above the groundwater surface.

2.1.3 Blower Unit

A 3-horsepower, positive-displacement blower unit was used at SS1 for the initial pilot test, and a 2-horsepower Gast® regenerative blower unit was installed for extended testing. The blower is energized by 230-volt, single-phase, 30-amp line power from a new distribution panel located on a new electrical panel installed adjacent to VW1 (Figure 2.1). The pilot test blower injected air into the subsurface at 32.9 standard cubic feet per minute (scfm) for the initial test at VW1. The injection flow rate was optimized at 21.8 scfm for VW1, VW2, VW3, and VW4, 12.0 scfm for VW5, and 18.5 scfm for VW6 for the extended pilot test. The final blower wiring was completed and the system was started up on April 4, 1996. The configuration, instrumentation, and specifications for the initial pilot test and extended pilot test units are shown on Following the field mobilization, Parsons ES engineers provided an Figure 2.10. and briefing checklist blower and maintenance (0&M)operations

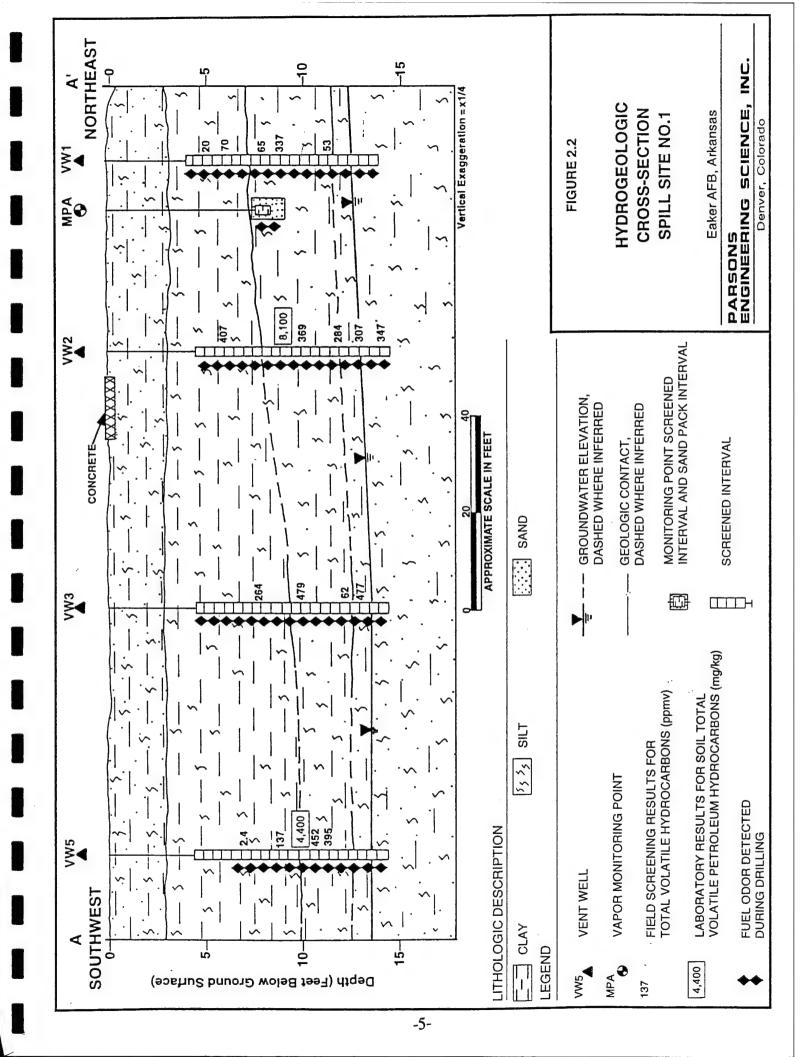


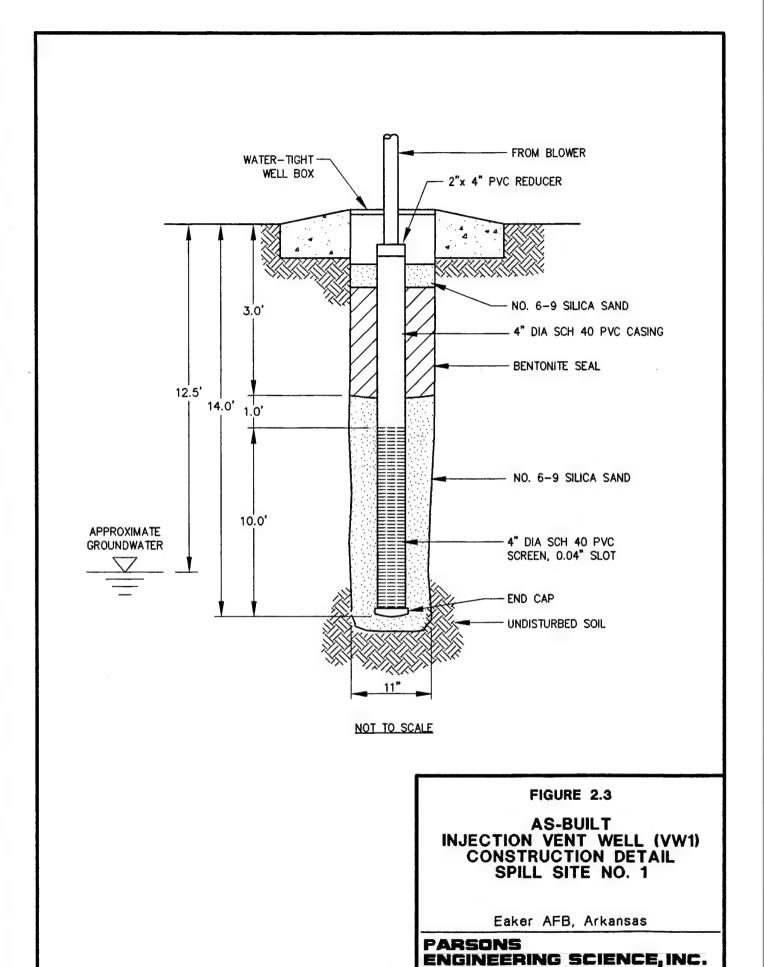
TABLE 2.1 VENT WELL AND MONITORING POINT CONSTRUCTION SUMMARY SPILL SITE NO. 1 EAKER AFB, ARKANSAS

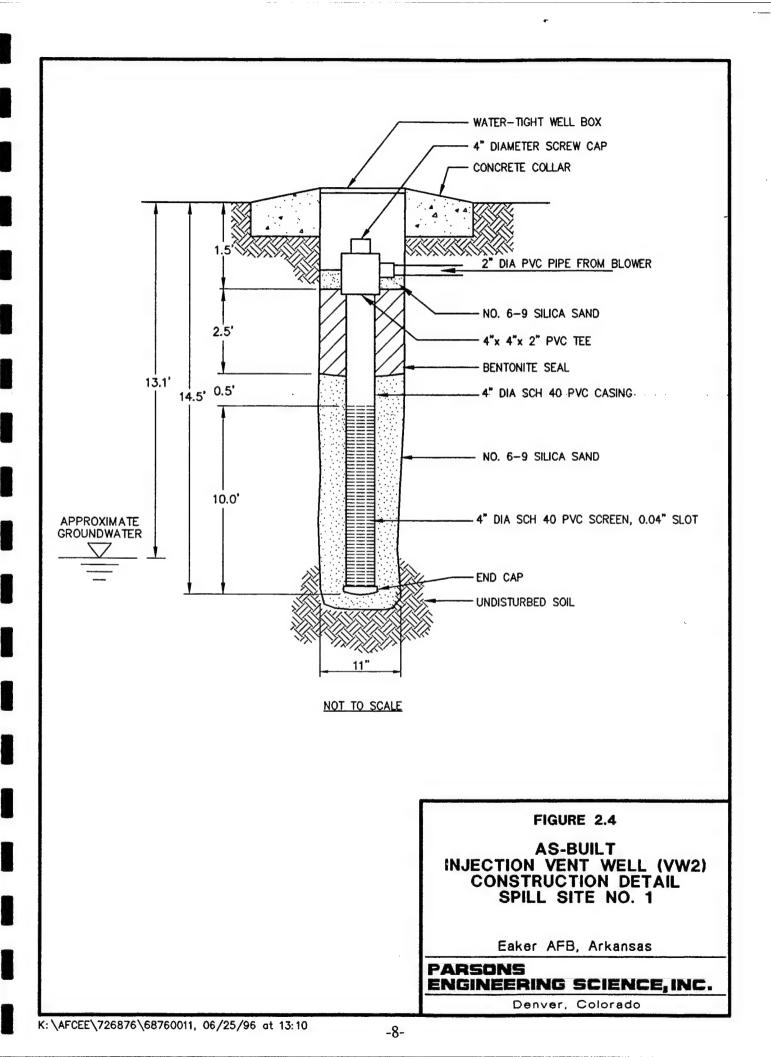
Location	Total Borehole Depth (feet bgs) a/	Screened Interval (feet bgs)
VW1	15	4-14
VW2	15	4.5-14.5
VW3	15	4.5-14.5
VW4	20	5-20
VW5	15	4.5-14.5
VW6 (MW205)	21.5	9.1-19.1
MPA	10	9
MPB	12.5	5, 8.5
MPC	11	5, 9
MPD	11	5, 9
MPE	9	9.5
MW207 b/	23.6	11.6-21.6
MW209 b/	27.5	15.5-25.5

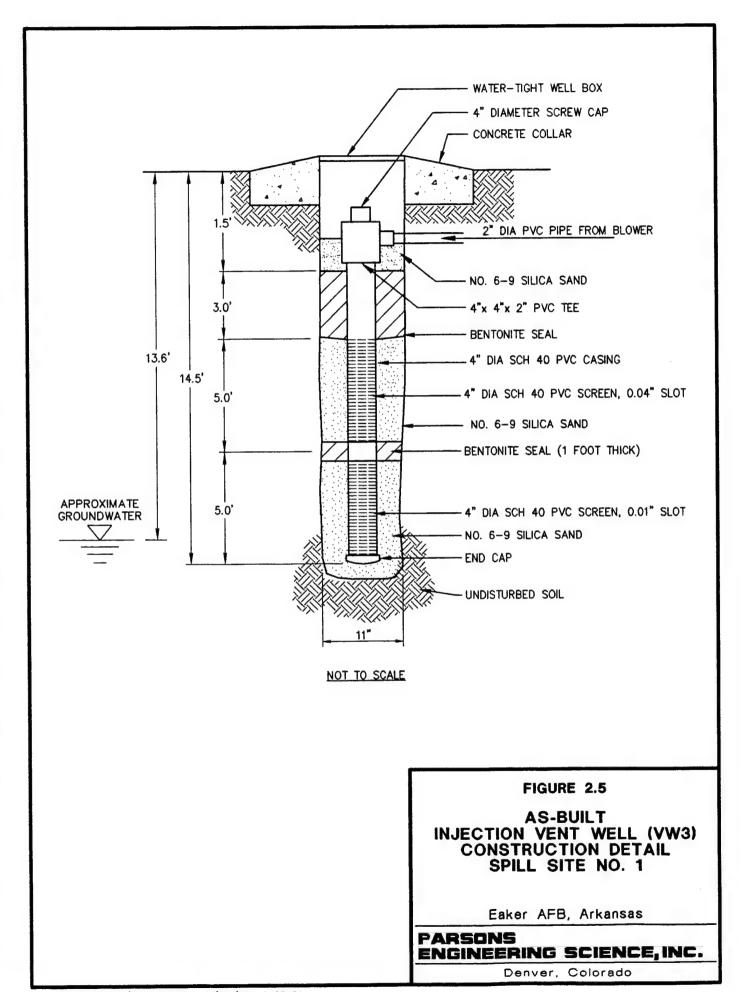
bgs = below ground surface.

Note: Vent wells VW1 through VW5 were completed on March 22-23, 1996, and monitoring points MPA through MPE were completed on March 20 and 27, and April 4, 1996.

This existing monitoring well was used as a vapor monitoring point.







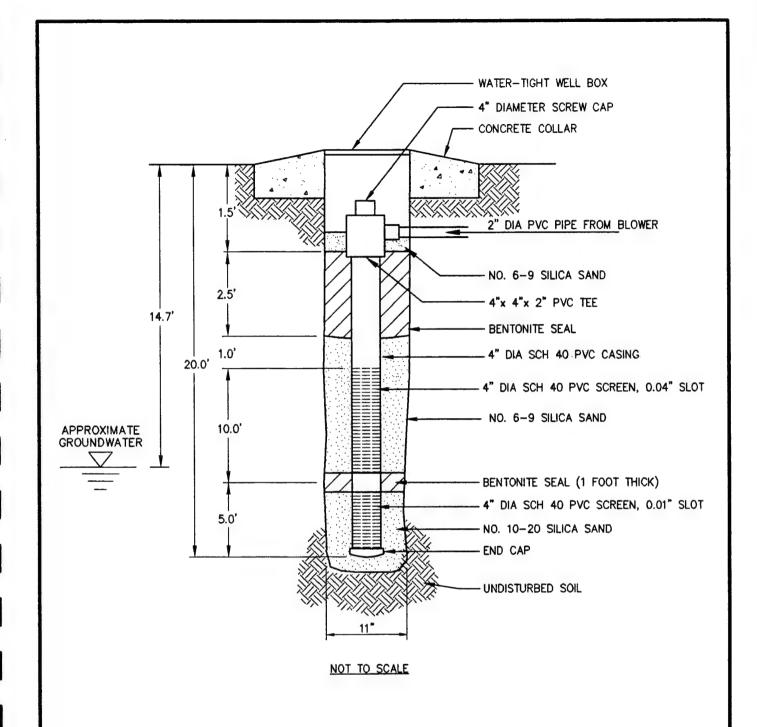


FIGURE 2.6

AS-BUILT
INJECTION VENT WELL (VW4)
CONSTRUCTION DETAIL
SPILL SITE NO. 1

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

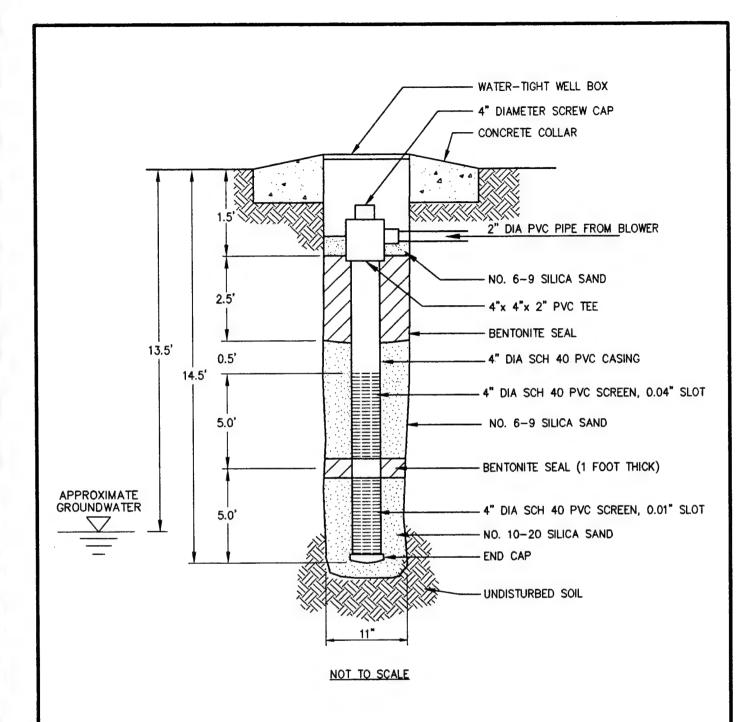
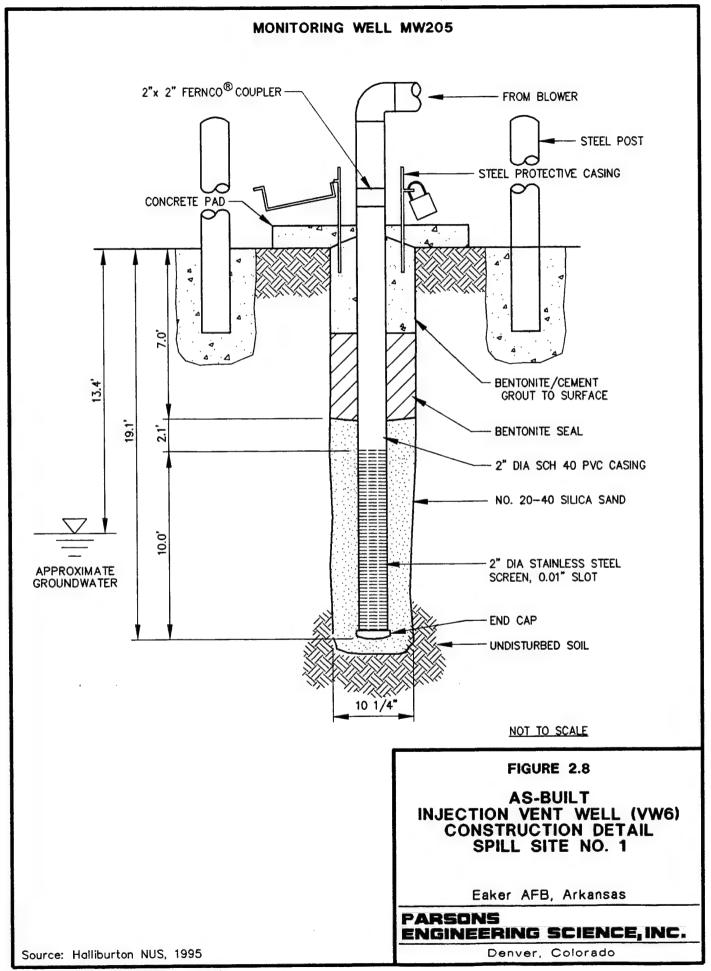


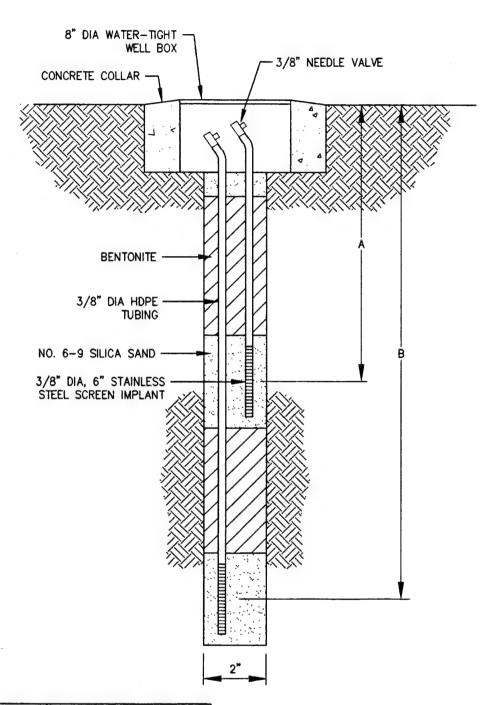
FIGURE 2.7

AS-BUILT
INJECTION VENT WELL (VW5)
CONSTRUCTION DETAIL
SPILL SITE NO. 1

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.





MONITORING POINT		SCREENED (ft bgs)a/
1 0	Α	В
MPA	NA ^b /	9.0
MPB	5.0	8.5
MPC	5.0	9.0
MPD	5.0	9.0
MPE	NA	9.5

a/ ft bgs = FEET BELOW GROUND SURFACE
b/ NA = NOT APPLICABLE

FIGURE 2.9

AS-BUILT MONITORING POINT CONSTRUCTION DETAIL (TYPICAL)
SPILL SITE NO. 1

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

LEGEND

- (1) INLET AIR FILTER SOLBERG F-30P-150
- (2) VACUUM GAUGE (IN H_2O)
- (3) BLOWER GAST $^{\oplus}$ 2.5HP R5125Q-50
- (4) MANUAL PRESSURE RELIEF (BLEED) VALVE 1 1/2" GATE
- (5) AUTOMATIC PRESSURE RELIEF VALVE
- (6) TEMPERATURE GAUGE (F)
- (7) PRESSURE GAUGE (IN H₂O)

BLOWER

FROM ATMOSPHERE

(6)

AIR FILTER

-14-

 \odot

- (8) FLOW CONTROL VALVE 1 1/2" GATE
- (9) FLOW MEASURING PORT FITTED WITH PLUG
- (10) STARTER
- (1) BREAKER BOX 240V/SINGLE PHASE/40 AMP

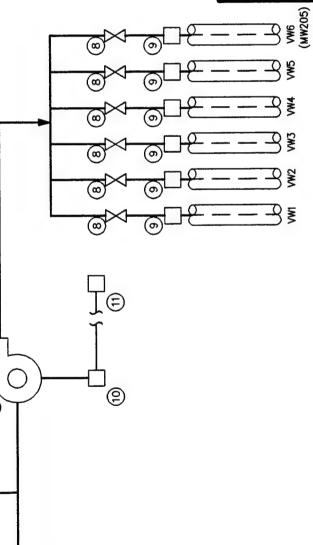
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AS-BUILT BLOWER SYSTEM INSTRUMENTATION DIAGRAM FOR AIR INJECTION

SPILL SITE NO.

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.



maintenance manual to AFBCA personnel. A copy of the checklist is provided in Appendix C.

The 2-horsepower blower system has sufficient reserve air-flow capacity to provide air to future, additional VWs if results of 1 year of extended pilot testing indicate that additional VWs are required to remediate the entire volume of contaminated soil at this site. Additional Geoprobe® borings and MPs will be installed during the May 1997 field mobilization to confirm that the full areal extent (FAE) of contamination is being treated (Section 2.4). The excess air flow is presently being bled off using the manual gate valve (Figure 2.10).

2.2 Pilot Test Soil and Soil Gas Sampling Results

2.2.1 Sampling Results

Soils at this site consist generally of approximately 8 to 10 feet of silty clay material overlying 1 to 4 feet of clayey silt and fine-grained sand. Groundwater was measured in each VW at a depth of approximately 12.5 to 14.7 feet below ground surface (bgs) following VW construction. The groundwater surface becomes deeper in the direction of Building 450 (Figure 2.2). More detailed geological information regarding SS1 can be found in the geological cross-section (Figure 2.2) and the geologic boring logs (Appendix A).

Petroleum-hydrocarbon-contaminated soils at this site were encountered beginning at depths ranging from approximately 5 feet bgs in the VW and MP boreholes and extended to below the groundwater surface at depths between 15 and 20 feet bgs. Contaminated soils were identified based on odor, staining, and headspace volatile organic compound (VOC) field screening results. Contaminated soils were encountered in all VW and MP boreholes, with the highest contaminant concentrations occurring in VW2, MPC, and MPD boreholes. Soils at these locations had a strong hydrocarbon odor, and a gray-stained soil layer was encountered at depths between approximately 6 and 14 feet bgs in each borehole (Figure 2.2).

Seven soil samples for laboratory analysis were collected from Geoprobe® polybutyrate liners or split-spoon samplers. Soil sample headspace was screened for VOCs using a photoionization detector (PID) and a total hydrocarbon vapor analyzer (THVA) to determine the presence of contamination and to select soil samples for laboratory analysis. Soil samples for laboratory analysis were collected from depths of 9 to 11 feet bgs from VW2, VW4, VW5, MPB, MPC, and MPD boreholes. A background soil sample was collected from an apparently uncontaminated area southwest of the site, near MW10, at a depth of 2.5 feet bgs. Soil samples were shipped via Federal Express® to Evergreen Analytical Laboratory in Wheat Ridge, Colorado for chemical and physical analysis. Soil samples were analyzed for total volatile petroleum hydrocarbons (TVPH) by US Environmental Protection Agency (EPA) Method SW8015 (modified); and for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method SW8020. Three samples also were analyzed for iron, alkalinity, total Kjeldahl nitrogen (TKN), and several physical parameters. The background soil sample was analyzed only for TKN. Copies of the chain-of-custody

SOIL AND SOIL GAS ANALYTICAL RESULTS EAKER AFB, ARKANSAS SPILL SITE NO. 1 TABLE 2.2

Analyte (Units) ^{a/}				Sample I	Sample Location-Depth (feet below ground surface)	epth irface)			
Soil Gas Hydrocarbons TVH ^{b'} (ppmv) Benzene (ppmv) Ethylbenzene (ppmv) Toluene (ppmv) Xylenes (ppmv)	VW2 60,000 670 120 190	32,000 230 51 110 25	22,000 100 58 130 71	VW6 17,000 74 51 160 44	MPA-9 5,900 43 24 48 50	MPB-8.5 6.6 ^ω 0.024 0.031 0.070 0.27M ^ω	MPC-9 16,000 110 51 87 50	MPD-9 20,000 63 39 92 11	MPE-9.5 1,600 34 39 140 42
Soil Hydrocarbons TVPH - Jet Fuel e' (mg/kg) Benzene (µg/kg) Toluene (µg/kg) Ethylbenzene (µg/kg)	XW2-9 8,800 < 560 < 560 54,000 160,000	VW4-10 280 280 < 57 < 57 810 2,000	VW5-9.5 4,400 < 570 < 570 19,000 30,000	MPB-9 620 < 56 < 56 1,800 7,600	MPB-9.5 3,200 < 230 < 230 12,000 41,000	MPC-10 11,000 <1,100 <1,100 85,000 180,000	MPD-9 7,800 < 550 < 550 50,000 46,000		
Soil Inorganics pH (pH units) Iron (mg/kg) Alkalinity (mg/kg) TKN (mg/kg) Phosphorus (mg/kg)	VW1-6.5 7.6 12,100 200 133 < 2.1	VW1-10 6.9 12,600 < 28.0 < 5.6 < 2.0	MPC-5.5 6.3 10,600 50.3 < 5.6 < 2.1	BG-2.5 g					
Soil Physical Parameters Moisture (% wt.) Gravel (%) Sand (%) Fines (Silt and Clay) (%)	VW1-6.5 10.5 0.0 22.1 77.9	11.8 0.0 87.9	MPC-5.5 10.8 0.0 68.9						

ppmv=parts per million, volume per volume; mg/kg=milligrams per kilogram; μg/kg=micrograms per kilogram; ΤΚΝ=total Kjeldahl nitrogen; TVH=total volatile hydrocarbons; TVPH=total volatile hydrocarbons; TVPH=total volatile petroleum hydrocarbons; wt.=weight. ъ

TVH referenced as jet fuel and analyzed by USEPA Method TO-3.

Reported value is invalid based on the elevated initial field TVH measurement. € € € €

M = Reported value may be biased due to apparent matrix interferences. TVPH referenced as jet fuel and analyzed for by USEPA Method SW8015 modified.

--- = Not analyzed.

I:\PROJECTS\726876\444.WW6

forms are included in Appendix A. The results of these analyses are provided in Table 2.2.

Nine soil gas samples for laboratory analyses were collected prior to performing the *in situ* respiration test in laboratory-provided, evacuated, 1-liter SUMMA® canisters. Soil gas samples were collected by extracting soil gas from VW2, VW3, VW4, VW6, MPA-9, MPB-8.5, MPC-9, MPD-9, and MPE-9.5. All soil gas samples were collected following procedures in the AFCEE bioventing pilot test protocol document (Hinchee *et al.*, 1992). Soil gas samples were shipped via Federal Express® to Air Toxics, Inc. in Folsom, California for total volatile hydrocarbon (TVH) and BTEX analysis by EPA Method TO-3. The results of these analyses are provided in Table 2.2.

2.2.2 Exceptions to Test Protocol Document Procedures and Work Plan

Procedures described in the protocol document (Hinchee et al., 1992) were used to complete the pilot tests at SS1, except thermocouples were not installed. During the May 1997 field event a thermocouple will be installed in a newly installed MP (Section 2.4). Because the drilling requirements at B457 Area (Section 3.0) and UST 702 (Section 4.0) were less than expected, additional work was performed at SS1 to fulfill the scope of work. Four additional VWs were installed, and well MW205 was used as a VW rather than wells MW203 and MW211. Well MW203 was damaged, and well MW211 does not have enough exposed screened interval. Additional soil gas samples also were collected and analyzed to better define the extent of contamination. Vent wells VW3, VW4, and VW5 were constructed with two types of slotted screen to facilitate air flow through the less permeable upper soil interval (Figures 2.5, 2.6, and 2.7).

2.3 Pilot Test Results

2.3.1 Initial Soil Gas Chemistry

Prior to initiating any air injection, soil gas in the newly installed VWs, all MPs, and eight of the existing groundwater monitoring wells (MW201, MW202, MW203, MW204, MW205, MW207, MW209, and MW211) was analyzed for initial oxygen, carbon dioxide, and TVH concentrations using portable gas analyzers, as described in the technical protocol document (Hinchee et al., 1992). Table 2.3 summarizes the initial soil gas chemistry. The VWs, MPs, and monitoring wells were purged until oxygen levels had stabilized to remove stagnant gas prior to collecting soil gas samples, and were measured.

Results indicate significant soil contamination northwest of the former tank excavation, extending to Building 450. Contamination appears to start at approximately 6 feet bgs near the northwestern edge of the former tank excavation, and extends to the groundwater at approximately 13 feet bgs. The soils appeared more grossly contaminated starting at a depth of approximately 8.5 feet bgs near the northwestern side of the former tank excavation. This depth interval corresponds to the smear zone near the water table.

TABLE 2.3 INITIAL SOIL GAS CHEMISTRY SPILL SITE NO. 1 EAKER AFB, ARKANSAS

Sample Location	Screen Depth (feet)	O ₂ (%)	CO ₂ (%)	Field TVH (ppmv) ^{a/}	Laboratory TVH (ppmv) b/
VW1	4-14	2.5	8.7	>20,000	c/
VW2	4.5-14.5	0.8	15.5	>20,000	60,000
VW3	4.5-14.5	0.0	19.0	>40,000	32,000
VW4	5-20	1.5	17.0	>40,000	22,000
VW5	4.5-14.5	20.8	0.4	260	
VW6 (MW205)	9.1-19.1	3.2	19.0	>40,000	17,000
MPA	9	1.4	15.0	>20,000	5,900
MPB	5	20.4	0.1	2,000	
MPB	8.5	2.2	12.0	>20,000	6.6 d/
MPC	5	20.5	0.7	4,200	
MPC	9	2.2	12.1	>20,000	16,000
MPD	5	e/	der 40° 40°		
MPD	9	1.5	14.2	>20,000	20,000
MPE	9.5	1.3	15.2	>40,000	1,600
MW201 f/	7-22	9.1	8.0	1,000	
MW202 f	6.6-21.6	8.5	4.3	4,800	
MW203 f/	6-21	4.2	11.2	>10,000	
MW204 f	NA	19.8	1.6	150	
MW207 f/	11.5-21.5	0.0	12.0	6,000	
MW209 g/	15.5-25.5	20.0	1.5	560	
MW211 f/	9-19	18.9	2.3	>10,000	

Total volatile hydrocarbon field screening results reported in parts per million, volume per volume.

Laboratory total volatile hydrocarbon analytical results referenced to jet fuel (molecular weight=156).

^{--- =} Not analyzed.

Laboratory result is suspect based on field soil gas measurements and soil analytical results.

Monitoring point screened interval was below perched groundwater.

Sample collected during the initial site visit on November 16, 1995.

Sample collected on May 20, 1996.

At most VWs and MP screened intervals within the expected area of contamination (excluding VW5, MPB-5, MPC-5, and MW209), soil gas oxygen concentrations were significantly below the atmospheric concentration of approximately 21 percent.

Depleted oxygen concentrations indicate significant biological activity and soil contamination. The most significant oxygen depletion was measured at depths greater than 8 feet bgs at MPA, MPB, MPC, MPD, and MPE, and at VW2, VW3, and VW4 where the oxygen concentrations were at or below 2.2 percent (Table 2.3).

Initial oxygen concentrations at the 5-foot depths at MPB and MPC, and at MW209 and VW5, ranged from 20.0 to 20.9 percent. These higher soil gas oxygen concentrations coupled with lower soil gas TVH concentrations indicate less fuel contamination (and less resulting biological activity) at shallower depths and at the southwestern and northwestern edges of the contamination. However, the apparently high oxygen concentration at VW5 may be the result of forced diffusion (via the sampling pump) from cleaner soils, because only about half of the well is screened within contaminated soil. Elevated oxygen concentrations at the shallower depths also may be a result of oxygen being supplied by natural diffusion from the atmosphere and nearby uncontaminated soils. Contamination near VW4, VW5, and VW6 (MW205) appears to be confined primarily to the smear zone near the water table.

Initial TVH field measurements at the VWs and MPs ranged from 260 to >40,000 parts per million, volume per volume (ppmv), and laboratory TVH results ranged from 1,600 to 60,000 ppmv. At MPB-8.5, a laboratory result of 6.6 ppmv TVH was reported; however, based on the high TVH field measurement (>20,000 ppmv), the result is considered invalid. At the time the laboratory received sample MPB-8.5, the vacuum of the SUMMA® canister was much higher than the other samples, so it is possible that the valve may not have been functioning properly at the time of sample collection. The highest TVH concentrations were measured at depths near the smear zone (8.5-11 feet bgs), indicating significant fuel contamination. At VW5, a low field soil gas TVH value of 260 ppmv was measured (Table 2.3). However, at a depth of 9.5 to 10.5 feet bgs, soil TVPH was detected at 4,400 milligrams per kilogram (mg/kg) (Table 2.2), indicating that smear zone contamination is present near VW5.

2.3.2 Air Permeability

To obtain data more representative of the eventual bioventing conditions at SS1, air was injected into VW1 for approximately 15.5 hours prior to the air permeability test in an attempt to dry out the soils and to create air flow pathways. Conducted according to protocol document procedures, the permeability test was performed by injecting air into VW1 for 1.2 hours at a rate of approximately 33 scfm and an average pressure of 41 inches of water. The maximum pressure response at each MP is listed in Table 2.4. The pressure measured at the MPs increased gradually throughout the test. Due to the long-term, gradual pressure response, the HyperVentilate® method of determining air permeability was selected. To determine the soil gas permeability, the soil profile was evaluated as two separate intervals: 1) the upper clay interval (3 to 7 feet bgs), and 2) the lower silt and sand interval (7 to 12.5 feet bgs). Because a negligible pressure response was observed in the upper soil interval, an accurate calculated permeability value was not obtainable; however, a permeability value of >0.1 darcys, typical for

TABLE 2.4 MAXIMUM PRESSURE RESPONSE AIR PERMEABILITY TEST SPILL SITE NO. 1 EAKER AFB, ARKANSAS

Location	Distance From VW1 (feet)	Screen Depth (feet bgs) a/	Elapsed Time to Maximum Pressure (minutes)	Maximum Pressure Response (inches of water)
MPA	10.2	9	73	6.35
MDD	20.2	5	73	0.0
MPB	20.2 20.2	8.5	73	4.9
MPC	32.8	5	52	0.03
	32.8	9	52	2.55

^{a/} bgs = below ground surface.

"tight" clays, is assumed. For the lower soil interval, a soil gas permeability value of approximately 52 darcys, typical for medium sand, was calculated for this site. A radius of pressure influence of at least 33 feet was observed at depths greater than 8 feet. At MPC-9, the measuring point farthest from VW1 at a distance of 33 feet, the maximum pressure response was 2.5 inches of water.

2.3.3 Oxygen Influence

The radius of oxygen increase in the subsurface resulting from air injection into the VWs during pilot testing is the primary design parameter for full-scale bioventing system design. Optimization of full-scale and multiple-VW systems require pilot testing to determine the volume of soil that can be oxygenated at a given flow rate and VW screen configuration.

Table 2.5 presents the changes in soil gas oxygen levels that occurred during a 15.5hour air injection period (using the pilot test blower) and a 46-day injection period (4/5/96 through 5/20/96) using the extended pilot test blower unit. Upon departure from the site on April 5, 1996, the air flow rates ranged from approximately 17.5 to 31.6 scfm at the six VWs; however, a significant air leak from VW6 had developed in the pipe trench near the blower shed sometime before April 30, 1996. This leak would have affected each of the VW's flow rates. On May 20, 1996, Parsons ES remobilized to the site to perform oxygen influence measurements and to repair the air leak. With the exception of MPB and MW203 (which is damaged), this period of air injection at vent wells VW1 through VW5 produced noticeable increases in soil gas oxygen levels at all MPs. Soil gas monitored at MW203 and the 8.5-foot depth interval at MPB showed decreases in oxygen concentrations, indicating that the soil gas was migrating outward from the area of higher contamination near vent wells VW1, VW3, and VW5 into the area of lesser contamination near MPB and MW203. Slight increases in oxygen concentrations were observed at MPE (centrally located approximately 40 feet from both VW1 and VW6) and MW207 (located 22 feet from VW4); however, monitoring during the extended 1-year pilot test will better define the effective treatment radius.

Based on measured changes in oxygen levels, it is anticipated that the radius of oxygen influence for a long-term bioventing system at this site will exceed 35 feet at depths below 6.5 to 9 feet bgs. Considering that a slight increase in oxygen concentration was observed at VW2 (43.8 feet from VW1) following 16 hours of air injection at VW1 with the pilot test blower, the radius of oxygen influence may exceed 44 feet at depths below 6.5 to 9 feet bgs. The clay soil interval above 6.5 to 9 feet bgs provides a "cap" that enhances the radius of oxygen influence in the deeper soils and minimizes VOC emissions to the surface. Currently, there are no discrete MP intervals located in oxygen-deficient soils in the upper clay interval, so it is difficult to estimate the radius of oxygen influence in the "tight" clays. During the May 1997 field event, additional multi-depth vapor MPs will be installed to monitor each soil interval and to more precisely determine the effective treatment area. Details of the proposed additional work is described in Section 2.4.

TABLE 2.5 INFLUENCE OF AIR INJECTION AT VWs ON MONITORING POINT OXYGEN CONCENTRATIONS SPILL SITE NO. 1 EAKER AFB, ARKANSAS

Location	Distance From VW1 (feet)	Distance From Next Nearest VW (feet)	Screen Depth (feet bgs) a/	Initial O ₂ b/ (%)	Final O ₂ c/ (%)	Final O ₂ d/ (%)
VW2	43.8	53.0 (from VW3)	4.5-14.5	0.8	1.2	e/
MPA	10.2	34.8 (from VW2)	9	1.4	7.7	17.8
MPB	20.2	50.0 (from VW2)	8.5	2.2	1.5	1.0
MPC	32.8	23.0 (from VW2)	9	2.2	4.2	18.1
MPD		29.3 (from VW3)	9	1.5		12.3
MPE	41.9	40 (from VW6)	9.5	1.3		1.6
MW203		32 (from VW5) 33 (from VW3)	6-21	4.2 ^f /		1.1
MW207	30 40 40	22 (from VW4)	11.6-21.6	0.0 5		1.0

^{a/} bgs = below ground surface.

Measurements taken prior to respiration testing and air injection at the VWs.

desurement taken after approximately 16 hours of air injection at VW1.

d' Measurements taken following approximately 46 days of air injection at the VWs (VW6 was leaking).

e/ --- = Not sampled.

^g Sample collected during the initial site visit on November 16, 1995.

2.3.4 In Situ Respiration Rates

Following the 16-hour air injection period and the 1.2-hour permeability test at VW1 with the pilot test blower, an *in situ* respiration test was performed by injecting a mixture of air (oxygen) and approximately 7-percent helium (inert tracer gas) into three

MP screened intervals (MPA-9, MPB-8.5, and MPC-9) and ambient air into VW2 and MPD-9 for a 16-hour period using 1-cubic-foot-per-minute (cfm) pumps. Oxygen loss and other changes in soil gas composition over time were then measured at these intervals. Oxygen, TVH, carbon dioxide, and helium were measured for a period of approximately 24 hours following air injection. The measured oxygen losses were then used to calculate biological oxygen utilization rates. The results of *in situ* respiration testing for VW2, MPA-9, MPB-8.5, MPC-9, and MPD-9 are presented in Figures 2.11 through 2.15, respectively. Table 2.6 provides a summary of the oxygen utilization and fuel degradation rates.

Because helium is a conservative, inert gas, the change in helium concentrations over time can be useful in determining the effectiveness of the bentonite seals between MP screened intervals. Figures 2.12 through 2.14 compare oxygen utilization and helium retention. Because the observed helium losses were negligible, and because helium will diffuse approximately three times faster than oxygen due to oxygen's greater molecular weight, the measured oxygen loss is the result of bacterial respiration and not due to diffusion away from the MPs. Additionally, the area near MPA, MPB, MPC, and VW2 was somewhat oxygenated from the air injection at VW1 with the pilot test blower unit.

Oxygen loss measured at VW2 and all MP intervals occurred at high rates, ranging from 0.97 percent per hour at VW2 to 1.25 percent per hour at MPC-9. At MPC-9, the oxygen level dropped from 19.5 percent to 1.6 percent in 23 hours.

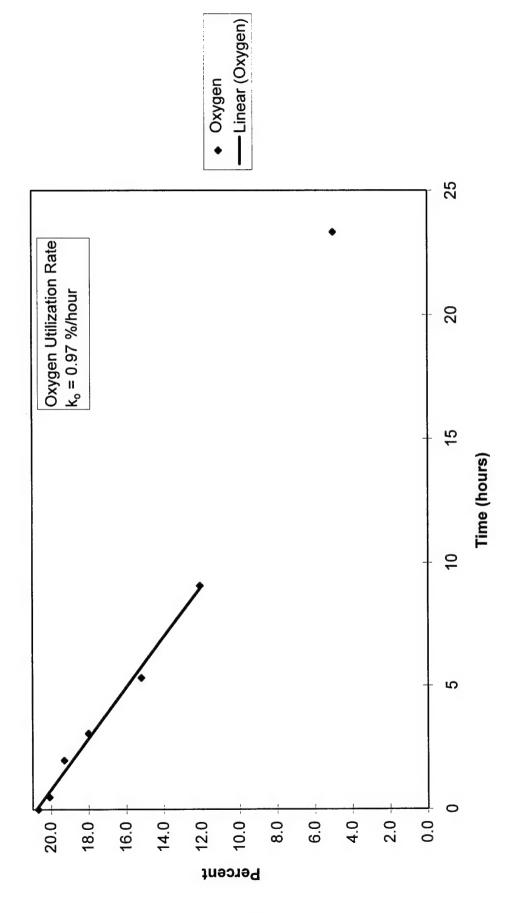
Based on these oxygen utilization rates, an estimated 1,560 to 2,010 milligrams (mg) of fuel per kilogram (kg) of soil can be degraded each year at this site. This conservative estimate is based on an average air-filled porosity of approximately 0.05 liter per kg of soil, and a ratio of 3.5 mg of oxygen consumed for every 1 mg of fuel biodegraded. Actual degradation rates may exceed these estimates.

2.3.5 Potential Air Emissions

The long-term potential for VOC air emissions from full-scale bioventing operations at this site is considered low because of the age and type of the site contaminants (greater than 5 years, and primarily JP-4 fuel); the very low air injection flow rates (12 to 21.8 scfm); the relatively impermeable clay soil overlying the clayey silt and fine-grained sand; and the nearby concrete cover. The majority of the injected air is flowing through soils below 7 feet bgs (Figure 2.2). Emissions should be minimal because accumulated vapors will move slowly outward from the air injection points and will be biodegraded as they move horizontally through the clayey silt and fine-grained sand layer. To confirm this, a GasTech® total hydrocarbon vapor analyzer will be used to monitor the breathing zone during the April 1997 field event. During pilot testing at SS1, health and safety monitoring of ambient air was not conducted because the windy

6/10/96

FIGURE 2.11
INITIAL RESPIRATION TEST RESULTS AT VW2
SPILL SITE NO. 1
EAKER AFB, ARKANSAS



W2

FIGURE 2.12
INITIAL RESPIRATION TEST RESULTS AT MPA-9
SPILL SITE NO. 1
EAKER AFB, ARKANSAS

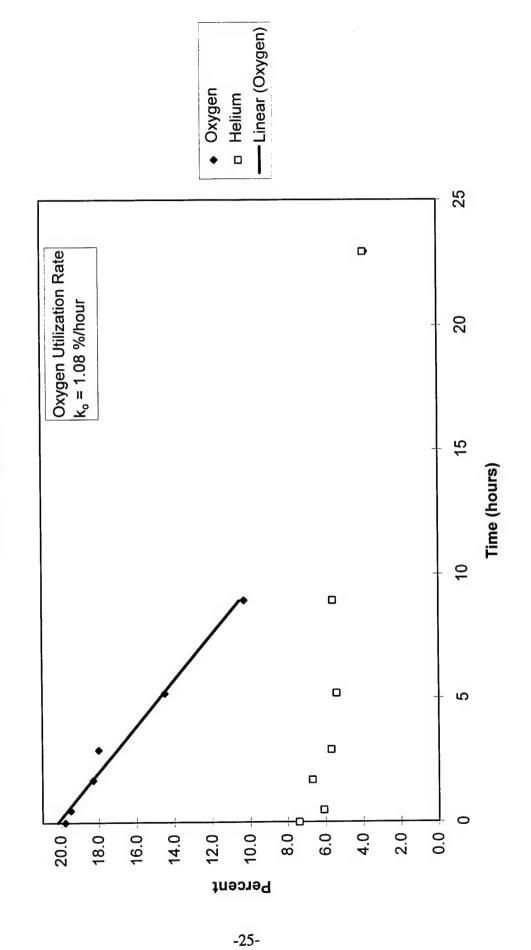
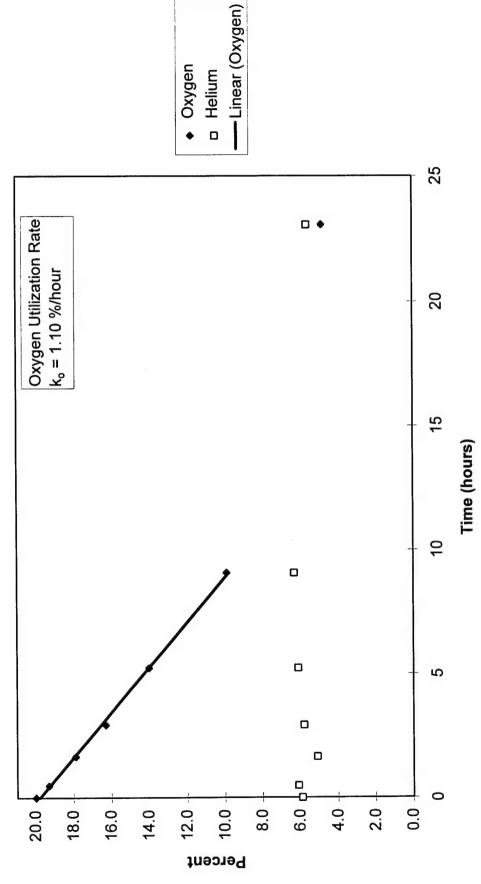
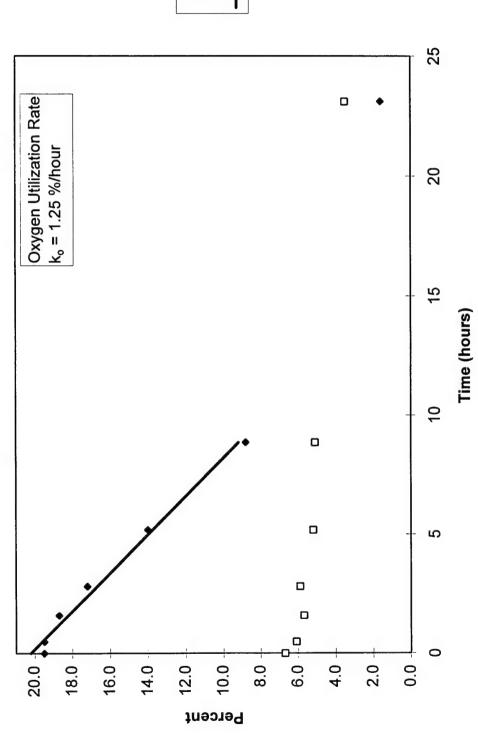


FIGURE 2.13
INITIAL RESPIRATION TEST RESULTS AT MPB-8.5
SPILL SITE NO. 1
EAKER AFB, ARKANSAS



MPA-9

FIGURE 2.14
INITIAL RESPIRATION TEST RESULTS AT MPC-9
SPILL SITE NO. 1
EAKER AFB, ARKANSAS



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FIGURE 2.15
INITIAL RESPIRATION TEST RESULTS AT MPD-9
SPILL SITE NO. 1
EAKER AFB, ARKANSAS

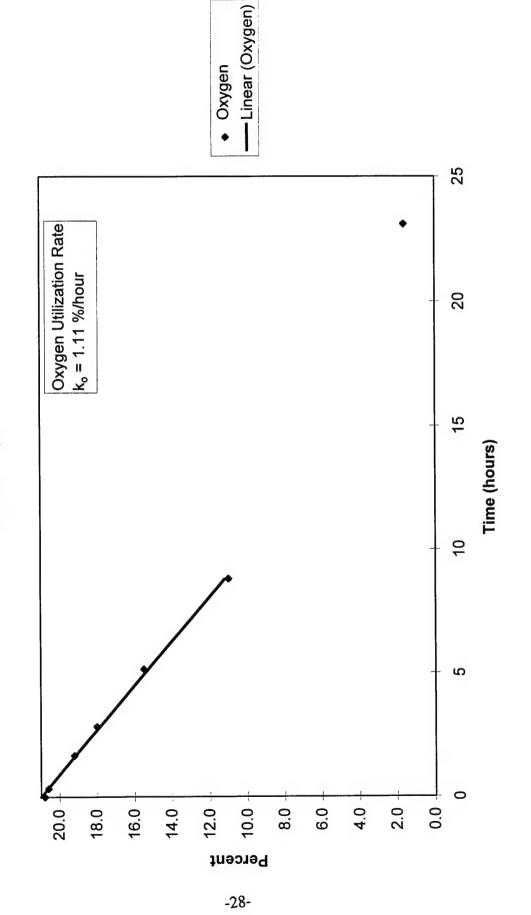


TABLE 2.6 OXYGEN UTILIZATION AND FUEL DEGRADATION RATES SPILL SITE NO. 1 EAKER AFB, ARKANSAS

Location- Depth (feet bgs) a/	Test Duration (hours)	0 ₂ Loss (%)	O ₂ Utilization Rate ^{b/} (%/hour)	Fuel Degradation Rate (mg TPH/kg/year) ^{c/}
VW2 4.5-14.5	9.1	8.6	0.97	1,560
MPA-9	9.0	9.5	1.08	1,740
MPB-8.5	9.1	10.1	1.10	1,775
MPC-9	8.9	10.7	1.25	2,010
MPD-9	8.8	9.8	1.11	1,790

bgs = below ground surface.
 Values based on best-fit lines (Figures 2.11 through 2.15).

e' mg TPH/kg/year = milligrams of total petroleum hydrocarbons degraded per kilogram of soil per year.

conditions that would have provided biased results. Finally, the site is very isolated on Eaker AFB, and is located several thousand feet from any permanently occupied building.

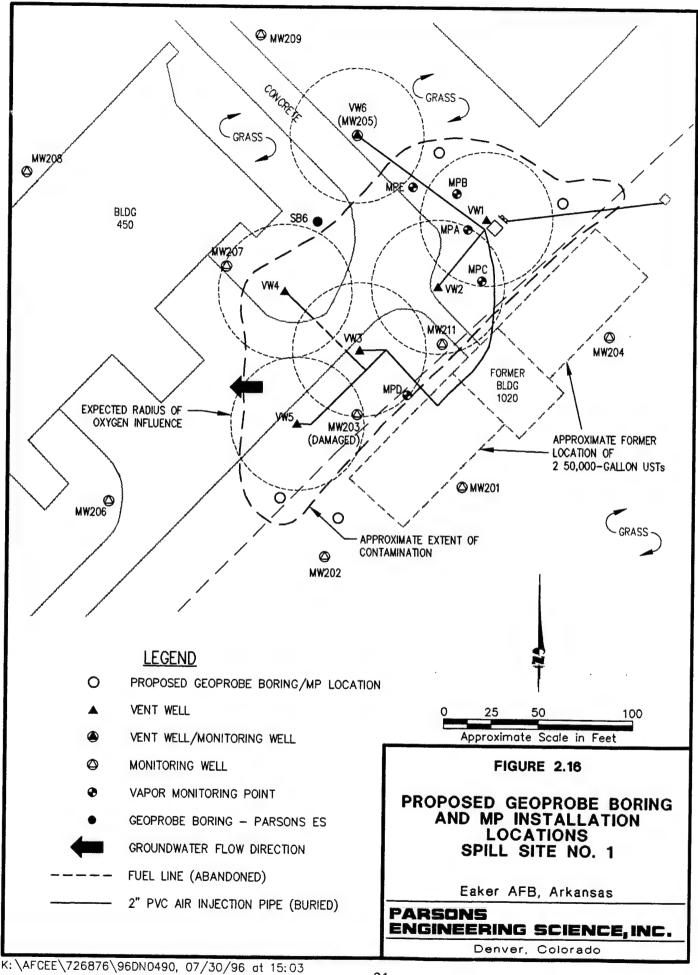
2.4 Recommendations

Initial bioventing tests at this site indicate that oxygen has been depleted in the contaminated soils, and that air injection is an effective method of increasing aerobic fuel biodegradation in the more permeable soil layer. Monitoring results after the first 46 days of extended testing indicate that the radius of influence exceeds 33 feet at a depth of 8 to 11 feet bgs. It is recommended that air injection continue at this site to determine the long-term radius of oxygen influence and the effects of time and available nutrients on fuel biodegradation rates.

A small, 2-horsepower regenerative blower has been installed at the site to continue air injection. The injection flow rates were optimized at 21.8 scfm for VW1, VW2, VW3, and VW4, 12.0 scfm for VW5, and 18.5 scfm for VW6 for the extended pilot test. The 1-year test period funded under Option 1 of the Extended Bioventing Project began on April 5, 1996. Parsons ES will operate the blower through April 7, 1997, conduct radius of oxygen influence measurements on April 7, 1997, shut off the blower and then conduct follow-up "area" respiration tests. Approximately 1 month later (May 1997), Parsons ES will mobilize the Geoprobe® rig to the site to perform additional soil sampling and MP installation. Figure 2.16 shows the proposed additional Geoprobe® boring and MP locations at SS1. In addition, during the May 1997 field event, Parsons ES will collect soil gas samples from the nine points that were sampled during the initial sampling event (Table 2.2) to determine the levels of cleanup achieved after 1 year of *in situ* treatment.

The current pilot-scale bioventing system appears to be treating most of the vadose zone contamination at SS1; however, one or more VWs may be required to treat the entire volume of contaminated soil. Based on results of soil gas surveys conducted by HNUS in 1991 and 1992, areas outside the current area of venting influence may have some residual vadose zone and smear zone contamination (HNUS, 1992). Appendix B contains a summary of the soil gas survey. Oxygen influence measurements taken at the end of 1 year of system operation will be used to determine the actual radius of influence and to assess the need for additional VWs. In particular, additional VWs may be required near MPE, MW202, and near the northern edge of the former tank excavation.

Based on a high field TVH measurement (4,800 ppmv) at MW202 and data from the soil gas surveys, another VW may be required near the southwestern edge of the former tank excavation. During May 1997, Parsons ES will install three additional multi-depth MPs near MW202 and VW5 to assess the need to utilize MW202 as an additional VW. Additional multi-depth MPs will be installed and constructed in the same manner as MPB, MPC, and MPD (Figure 2.9); a thermocouple will be installed in one of these MPs. Also, based on the soil gas surveys, some untreated soils may remain near the northern edge of the former excavation. Soil gas sample E224 indicated that high levels of VOCs are present near the northern edge of the former tank excavation (HNUS, 1992). If the actual radius of oxygen influence is less than 40



feet, it is expected that another VW will be required to treat soils near MPE. A multidepth MP will be located approximately 25 feet northeast of MPE to further delineate the FAE of contamination. Soil and soil gas samples will be collected for laboratory analysis from this MP. It is anticipated that an additional 6 soil samples and 5 soil gas samples will be collected for laboratory analyses from proposed Geoprobe[®] borings/MPs.

Data from over 120 Air Force bioventing sites indicate that BTEX compounds are preferentially biodegraded over total recoverable petroleum hydrocarbons (TRPH). Because BTEX compounds are among the most toxic and mobile fuel constituents, a BTEX soil cleanup standard typically is a risk-based standard. Within the AFCEE Risk-Based Petroleum Hydrocarbon "Tool Box", the report entitled "Using Risk-Based Standards will Shorten Cleanup Time at Petroleum Contaminated Sites" summarizes the BTEX/TRPH issue and will assist Eaker AFBCA in negotiating a BTEX cleanup standard. Available information indicates that the Arkansas Department of Pollution Control and Ecology (ADPC&E) requires cleanup to BTEX and TPH clean-up levels. This decision is made in conjunction with the results from a risk evaluation on a site-by-site basis. In conclusion, a risk-based approach to soil remediation (i.e., one in which BTEX is targeted for remediation) likely will expedite site closure while reducing overall costs and being protective of human health and the environment.

In general, quantitative destruction of BTEX will occur over a 1- to 2-year bioventing period. Soil gas surveys and respiration tests can be used as indicators of BTEX destruction. If a non-risk-based/TPH cleanup is chosen, the full-scale bioventing system should be operated until respiration rates approach background rates. Parsons ES recommends that confirmatory soil sampling be conducted 4 to 6 months after background respiration rates are approached.

3.0 PILOT TEST RESULTS - BUILDING 457 AREA

The source of contamination at this site was a 20,074-gallon UST formerly used to store diesel fuel oil. The tank, along with the majority of grossly contaminated soil has been removed (Ogden, 1995).

3.1 Pilot Test Design and Construction

An initial bioventing pilot test was performed by Parsons ES at the B457 Area during the period from March 18 through April 5, 1996. A total of six Geoprobe® boreholes were drilled at the site to better define the extent of the contamination, and to determine appropriate vapor MP screen depths and locations and optimal (VW) placement. Because the petroleum contamination at B457 Area is localized, two existing monitoring wells were used as VWs. Installation of three single-depth vapor MPs took place on March 18 and 19, 1996. The MPs were installed in Geoprobe® boreholes. Electrical services were provided by Cache Valley Electric of Blytheville, Arkansas.

Three MPs, a blower unit, and air injection piping to two monitoring wells were installed at Building 457 Area. Existing well TW1502 also was used as a MP. Figure 3.1 is a site layout showing the locations of the monitoring wells (TW1501 and TW1503) used for air injection, MPs, blower unit, and other existing groundwater monitoring wells at the site. The hydrogeology of the site is depicted on the cross-section on Figure 3.2. Boring logs for the MPs and VWs are included in Appendix A. The background MP for this site was existing groundwater monitoring well MW10, which is screened several feet above the groundwater surface. MW10 is located approximately 1,000 feet southeast of Building 457. The following sections describe the final design and installation of the bioventing system at the B457 Area.

3.1.1 Air Injection Vent Wells

Existing temporary groundwater monitoring wells TW1501 (VW2) and TW1503 (VW1) are being used as VWs at B457 Area. The wells were installed in oxygen-deficient soils north and south of the former tank excavation. The VWs are constructed of 2-inch-diameter, schedule 40 PVC casing and slotted PVC screen. Table 3.1 summarizes the well construction details. Details of the VW constructions are presented on Figures 3.3 and 3.4.

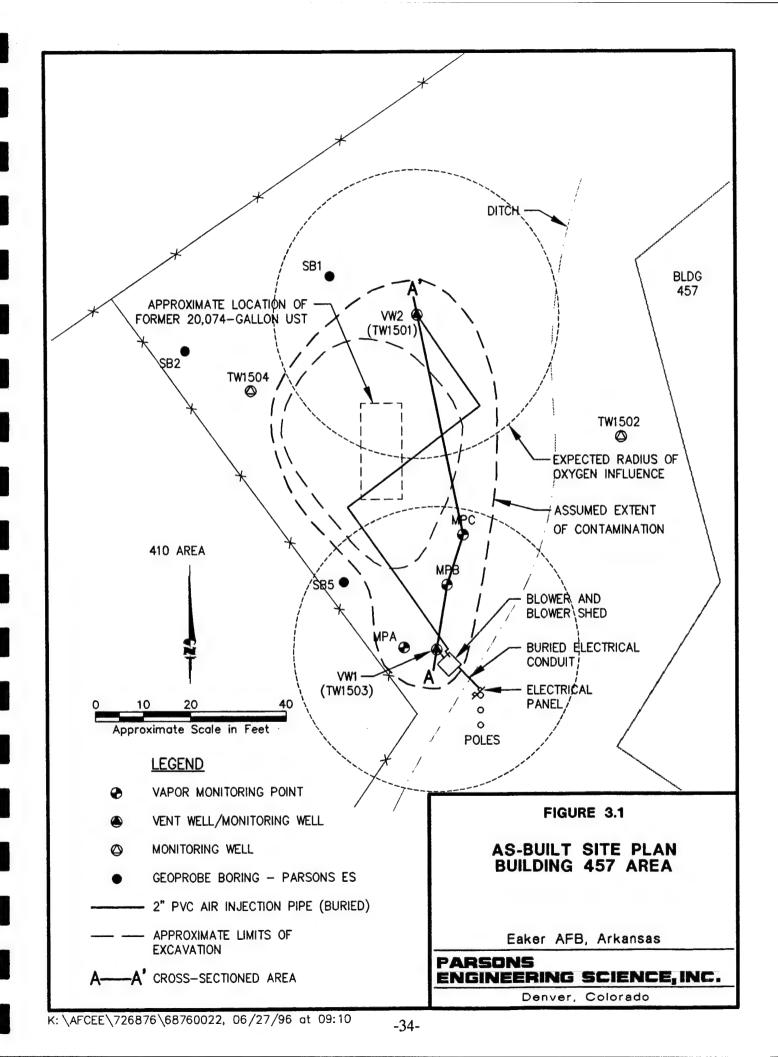
3.1.2 Monitoring Points

The single-depth MP screens were installed at the depths listed on Table 3.1. The three MPs (MPA, MPB, and MPC) at this site were constructed as shown in Figure 3.5. Each MP, installed in Geoprobe® borings, was constructed with a single 6-inchlong, 0.25-inch-OD stainless steel screen implant attached to 0.5-inch-OD, HDPE tubing that extends to the ground surface. The top of each 0.5-inch HDPE riser was completed with a 3/8-inch needle valve in a flush-mounted metal well protector set in concrete.

The existing groundwater monitoring well MW10, was used as the background MP for this pilot test. MW10 is located in an uncontaminated area approximately 1,000 feet southeast of Building 457 and has a screened interval extending above the groundwater surface.

3.1.3 Blower Unit

A 1-horsepower Gast® regenerative blower unit was used for the initial pilot test and was installed for extended testing. The blower is energized by 460-volt, three-phase, 15-amp line power from a new distribution panel located on a new electrical panel installed on the power pole adjacent to VW1 (Figure 3.1). The pilot test blower injected air into the subsurface at 11.5 scfm for the initial test at VW1, and the air injection flow rate for each VW was optimized at 14.7 scfm for the extended pilot test. The final blower wiring was completed, and the system was started on April 2, 1996. The configuration, instrumentation, and specifications for the initial pilot test and extended pilot test units are shown on Figure 3.6. Following the field mobilization, Parsons ES engineers provided an O&M briefing checklist and blower maintenance manual to AFBCA personnel. A copy of the checklist is provided in Appendix C.



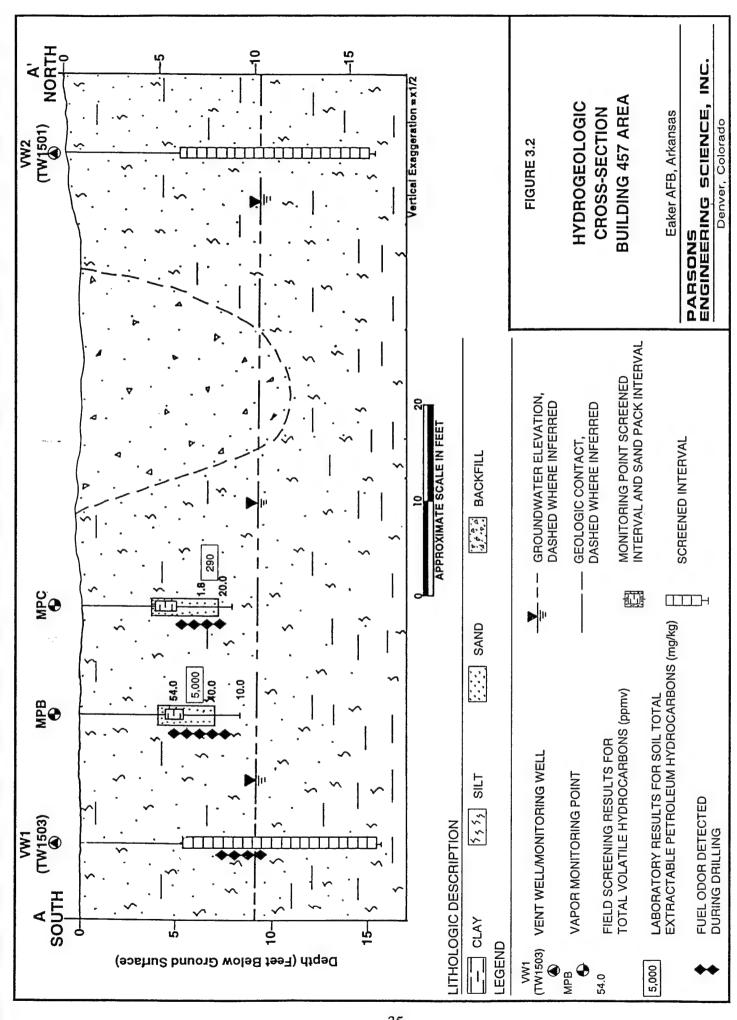
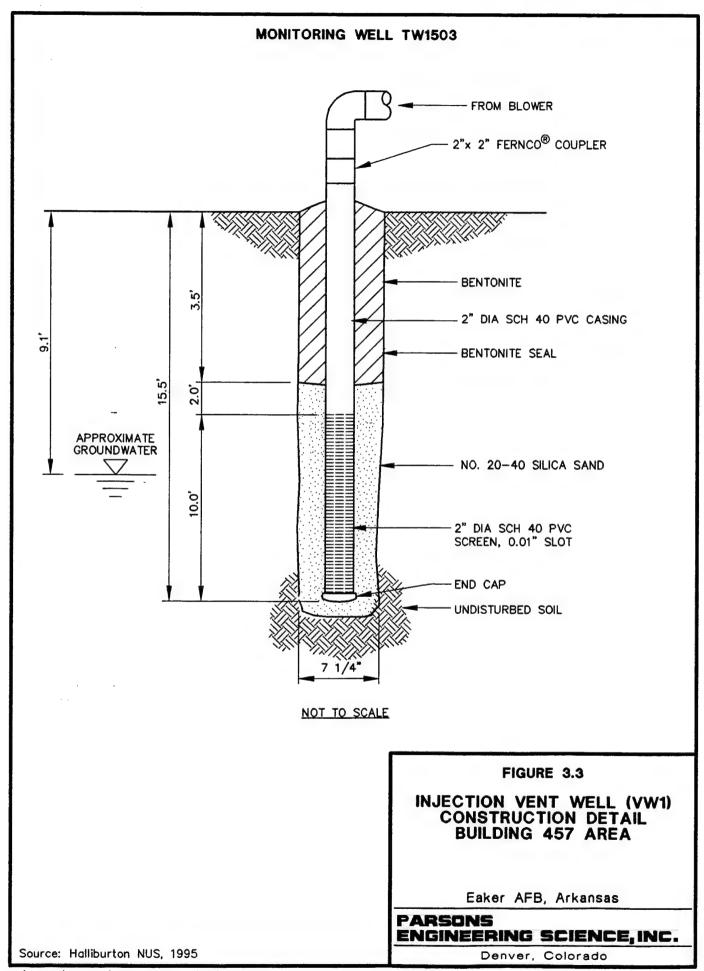


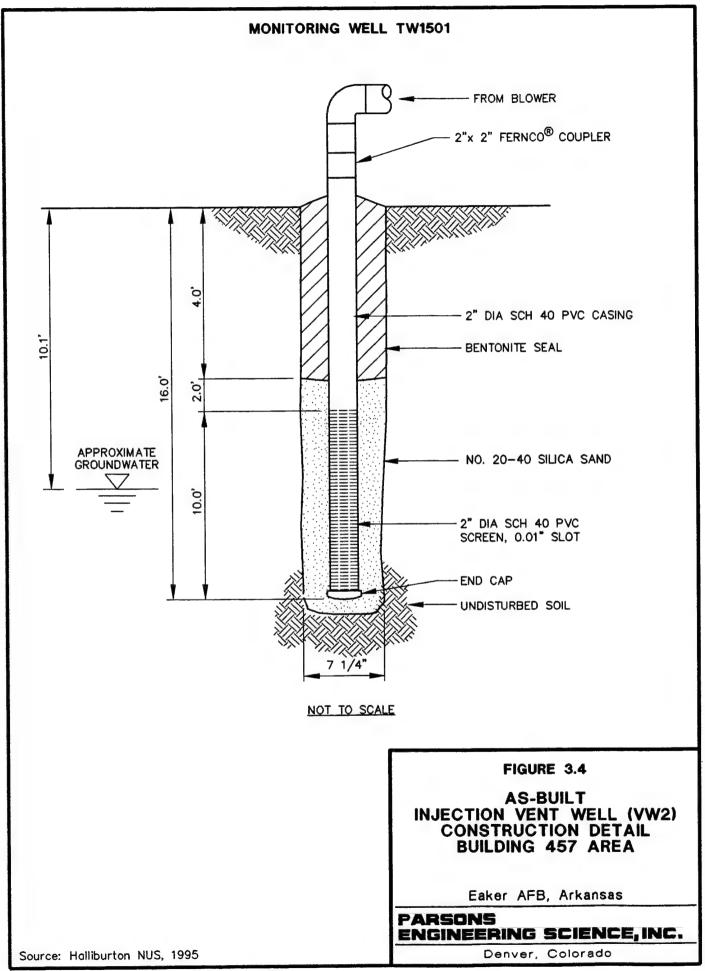
TABLE 3.1 VENT WELL AND MONITORING POINT CONSTRUCTION SUMMARY BUILDING 457 AREA EAKER AFB, ARKANSAS

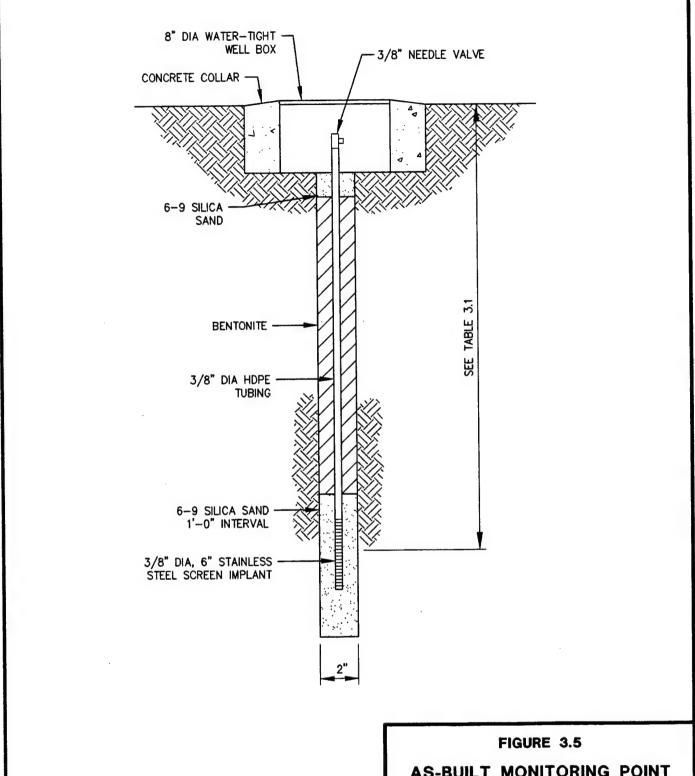
Location	Total Borehole Depth (feet bgs) a	Screened Interval (feet bgs)	
VW1 (TW1503)	16	5.5-15.5	
VW2 (TW1501)	16.5	6-16	
MPA	9	5.5	
MPB	8.5	5	
MPC	7.5	4.5	

bgs = below ground surface.

Note: The monitoring points were completed on March 19, 1996.







AS-BUILT MONITORING POINT CONSTRUCTION DETAIL BUILDING 457 AREA (TYPICAL)

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

LEGEND

- (1) INLET AIR FILTER SOLBERG F-30P-150
- (2) VACUUM GAUGE (IN H_2O)
- (3) BLOWER GAST®1.0HP R4310P-50
- (4) MANUAL PRESSURE RELIEF (BLEED) VALVE 1 $1/2^{\circ}$ GATE
- (5) AUTOMATIC PRESSURE RELIEF VALVE
- (6) TEMPERATURE GAUGE (F)
- (7) PRESSURE GAUGE (IN H2O)
- (8) FLOW MEASURING PORT FITTED WITH PLUG
- (9) FLOW CONTROL VALVE 1 1/2" GATE
- (10) STARTER
- (1) BREAKER BOX 230V/THREE PHASE/15 AMP

NO SCALE

FIGURE 3.6

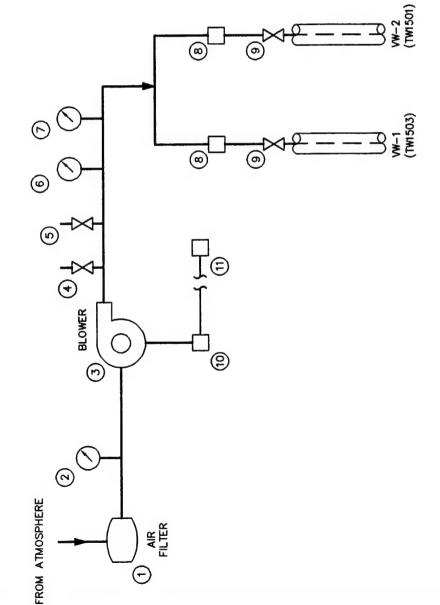
AS-BUILT BLOWER SYSTEM INSTRUMENTATION DIAGRAM FOR AIR INJECTION BUILDING 457 AREA

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

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The 1.0-horsepower blower system has sufficient reserve air-flow capacity to provide air to future, additional VWs if results of additional sampling at the site during the 1-year sampling event indicate that additional VWs are required to remediate the entire volume of contaminated soil at this site (see Section 3.4). The excess air flow is presently being bled off using the manual gate valve (Figure 3.6).

3.2 Pilot Test Soil and Soil Gas Sampling Results

3.2.1 Sampling Results

Unsaturated soils at this site consist generally of approximately 8 to 9 feet of silty clay, and clayey silt with traces of sand (Figure 3.2). Groundwater was measured in VW1 (TW1503) and in VW2 (TW1503) at depths of approximately 9 and 10 feet bgs, respectively, prior to air injection. At MPA perched water was initially observed at a depth of 5 feet bgs. More detailed geological information regarding B457 Area can be found in the geological cross-section (Figure 3.2) and the geologic boring logs (Appendix A).

Petroleum-hydrocarbon-contaminated soils at this site were encountered beginning at a depth of approximately 4.5 feet bgs in each MP borehole and extended to the groundwater surface at depths between 7 and 9 feet bgs. Contaminated soils were identified based on odor, staining, and headspace VOC field screening results. Contaminated soils were encountered in all MP boreholes, with the highest contaminant concentration occurring in the MPB borehole. Soils at these locations had a mild to strong hydrocarbon odor, and a gray-stained soil layer was encountered at depths between approximately 5 and 9 feet bgs in the MP boreholes (Figure 3.2).

Three soil samples for laboratory analysis were collected from Geoprobe® polybutyrate liners. Soil sample headspace was screened for VOCs using a PID to determine the presence of contamination and to select soil samples for laboratory analysis. Soil samples for laboratory analysis were collected from 5 feet bgs from MPA and MPB, and from a depth of 6 feet from MPC. A background soil sample was collected from an apparently uncontaminated area approximately 1,000 feet southeast of the site at a depth of 2.5 feet bgs. Soil samples were shipped via Federal Express® to Evergreen Analytical Laboratory in Wheat Ridge, Colorado for chemical and physical analysis. Soil samples were analyzed for total extractable petroleum hydrocarbons (TEPH) by EPA Method SW8015 (modified); and for BTEX by EPA Method SW8020. Samples were also analyzed for iron, alkalinity, TKN, and several physical parameters. The background soil sample was analyzed only for TKN. Copies of the chain-of-custody forms are included in Appendix A. The results of these analyses are provided in Table 3.2.

Soil gas samples for laboratory analyses were collected prior to performing the *in situ* respiration test in laboratory-provided, evacuated, 1-liter SUMMA® canisters. Soil gas samples were collected by extracting soil gas from VW1; and at depths of 5 feet from MPB and 4.5 feet from MPC. All soil gas samples were collected following procedures in the protocol document (Hinchee *et al.*, 1992). Soil gas samples were shipped via Federal Express® to Air Toxics, Inc. in Folsom, California for TVH and

BTEX analysis using EPA Method TO-3. Copies of the chain-of-custody forms are included in Appendix A. The results of these analyses are provided in Table 3.2.

The maximum concentration of TEPH measured in subsurface soils was 5,000 mg/kg at 5 feet bgs from MPB. For each soil and soil gas sample, BTEX concentrations were very low, with the exception of the soil sample from MPB, which contained 3.4 mg/kg of xylenes.

3.2.2 Exceptions to Test Protocol Document Procedures and Work Plan

Procedures described in the protocol document (Hinchee et al., 1992) were used to complete pilot tests at B457 Area. The only exceptions were that a thermocouple was not installed in a vapor MP and helium was not used during the respiration test. Prior to air injection for the respiration testing, the helium regulator was found to be faulty. Also, an initial soil gas sample for laboratory analysis was not collected from MPA because the screened interval was under perched water. Because the contamination at this site is so shallow and localized, only three soil samples were collected.

Because most of the contaminated soil was removed during tank removal activities, limited areas of contamination remain adjacent to the former tank excavation. Because existing monitoring wells TW1501 and TW1503 are placed in oxygen-deficient soils and are screened above the groundwater table, these wells were used as VWs. Therefore, a VW was not installed as proposed in the work plan. Moreover, because additional work was performed at SS1, the proposed work at the 410 Area (adjacent to B457 Area) was not conducted.

3.3 Pilot Test Results

3.3.1 Initial Soil Gas Chemistry

Prior to initiating any air injection, soil gas in the VWs (TW1503 and TW1501), all MPs, and two of the other existing groundwater monitoring wells (TW1504 and TW1502) was analyzed for initial oxygen, carbon dioxide, and TVH concentrations using portable gas analyzers, as described in the technical protocol document (Hinchee et al., 1992). Table 3.3 summarizes the initial soil gas chemistry. The VWs, MPs, and MWs were purged until oxygen levels had stabilized to remove stagnant gas prior to collecting soil gas samples.

At the VWs and all MP screened intervals, soil gas oxygen concentrations were below the atmospheric concentration of approximately 21 percent. Depleted oxygen concentrations indicate significant biological activity and soil contamination. The most significant oxygen depletion was measured at depths of 4 to 7 feet bgs at MPB and MPC, where the oxygen concentrations were at 0.0 percent. Soil gas BTEX concentrations were 5.5 ppmv and 0.5 ppmv, respectively. Results indicate only slight soil BTEX contamination at the VWs and at each MP. Oxygen concentrations of less than or equal to 5.1 percent were observed at these locations, indicating significant biological activity associated with contaminated soils. Initial oxygen concentrations at monitoring wells TW1502 and TW1504 were measured at 9.5 and 7.9 percent, respectively (Table 3.3). These higher soil gas oxygen concentrations indicate less fuel

TABLE 3.2 SOIL AND SOIL GAS ANALYTICAL RESULTS BUILDING 457 AREA EAKER AFB, ARKANSAS

Analyte (Units) ^{a/}	Sample Location-Depth (feet below ground surface)			
Soil Gas Hydrocarbons TVH ^{b'} (ppmv) Benzene (ppmv) Ethylbenzene (ppmv)	<u>VW1</u>	MPB-5	MPC-4.5	
	48	380	81	
	0.016	0.34	0.13M°'	
	0.048	1.5	0.084	
Toluene (ppmv) Xylenes (ppmv)	0.17	2.7	0.024	
	0.80	0.93	0.28	
Soil Hydrocarbons TEPH - diese ^µ / (mg/kg) Benzene (µg/kg) Toluene (µg/kg) Ethylbenzene (µg/kg) Xylenes (µg/kg)	MPA-5	MPB-5	MPC-6	
	1,900	5,000	290	
	< 2.4	< 230	< 0.4	
	< 2.4	< 230	< 0.4	
	< 2.4	< 230	< 0.4	
	6.8	3,400	< 0.4	
Soil Inorganics pH (pH units) Iron (mg/kg) Alkalinity (mg/kg) TKN (mg/kg) Phosphorus (mg/kg)	MPB-5 6.8 14,100 < 30.3 150 < 2.4	MPB-6 7.1 17,000 < 30.5 150 < 2.6	BG-2.5 e' < 4.6 	
Soil Physical Parameters Moisture (% wt.) Gravel (%) Sand (%) Fines (Silt and Clay) (%)	MPB-5 17.4 0.0 46.5 53.5	MPB-6 17.9 0.0 52.0 48.0		

a/ ppmv=parts per million, volume per volume; mg/kg=milligrams per kilogram; µg/kg=micrograms per kilogram; TKN=total Kjeldahl nitrogen; TVH=total volatile hydrocarbons; TEPH=total extractable petroleum hydrocarbons; wt.=weight.

b/ TVH referenced as jet fuel (molecular weight=156) and analyzed by USEPA Method

c/ M = Reported value may be biased due to apparent matrix interferences.

d/ TEPH analyzed for by USEPA Method SW8015 modified for diesel fuel.

e/ --- = Not analyzed.

TABLE 3.3 INITIAL SOIL GAS CHEMISTRY BUILDING 457 AREA EAKER AFB, ARKANSAS

Sample Location	Screen Depth (feet)	O ₂ (%)	CO ₂ (%)	Field TVH (ppmv) ^{a/}	Laboratory TVH (ppmv) b/
VW1 (TW1503)	5.5-15.5	5.0	8.0	540	48
VW2 (TW1501)	6-16	2.5	10.3	540	c/
$MPA^{d\prime}$	5.5	5.1	1.6	230	***
MPB	5	0.0	8.0	3,200	380
MPC	4.5	0.0	8.1	920	81
TW1502e/	8-18	9.5	7.3	94	***
TW1504 ^{e/}	5.5-15.5	7.9	5.9	140	

Total volatile hydrocarbon field screening results reported in parts per million, volume per volume.

Laboratory total volatile hydrocarbon analytical results referenced to jet fuel (molecular weight=156).

^{--- =} Not analyzed.

Sample could not be collected prior to air injection for the respiration test because the screened interval was under perched groundwater. Therefore, soil gas chemistry after initial air injection and prior to air injection for the permeability test is presented. The initial oxygen concentration may have been slightly lower than the value shown; however, based on respiration data and sufficient time for soil gas stabilization, the reported oxygen concentrations may closely represent initial soil gas concentrations.

Sample collected during the initial site visit on November 16, 1995.

contamination (and less resulting biological activity) at the monitoring wells. The relatively elevated oxygen concentrations at these monitoring wells may be the result of oxygen being supplied by natural diffusion from the atmosphere and the nearby backfill. Smear zone contamination may be affecting oxygen concentrations in these wells.

TVH field measurements at the VW and MPs ranged from 540 to 3,200 ppmv, and laboratory TVH results ranged from 48 to 380 ppmv. The highest TVH concentrations were measured at depths below 4 feet, indicating an interval of significant fuel contamination.

3.3.2 Air Permeability

An air permeability test was conducted according to protocol document procedures. Air was injected into VW1 for 2 hours at a rate of approximately 11.5 scfm and an average pressure of 26 inches of water. The maximum pressure response at each MP is listed in Table 3.4. The pressure measured at the MPs increased rapidly during the first 5 minutes of the test, then at a much slower rate for the remainder of the test. Due to the rapid pressure response, the steady-state method of determining air permeability was selected. A soil gas permeability value of approximately 8 darcys, typical for silty, sandy clay soil, was calculated for this site. A radius of pressure influence of at least 25 feet was observed at depths greater than 4 feet. At MPC-4.5, the farthest measuring point from VW1 at a distance of 24.5 feet, the maximum pressure response was 0.05 inch of water. At MPA-5.5, 5.5 feet from VW1, the maximum pressure response was 1.4 inches of water.

3.3.3 Oxygen Influence

The radius of oxygen increase in the subsurface resulting from air injection into the VW during pilot testing is the primary design parameter for full-scale bioventing system design. Optimization of full-scale and multiple VW systems require pilot testing to determine the volume of soil that can be oxygenated at a given flow rate and VW screen configuration.

Table 3.5 presents the changes in soil gas oxygen levels that occurred during a 47-day injection period using the extended pilot test blower unit. This period of air injection at approximately 13.0 scfm per VW produced increases in soil gas oxygen levels at each MP screened interval. A decrease in soil gas oxygen was observed at well TW1502, indicating that the soil gas was migrating outward from the area of higher contamination into the area of lesser contamination. Based on measured changes in oxygen levels, it is anticipated that the radius of influence for a long-term bioventing system at this site will exceed 25 feet at all depths. Monitoring during the extended pilot test at this site will better define the effective treatment radius.

3.3.4 In Situ Respiration Rates

The *in situ* respiration test was performed by injecting air (oxygen) into VW1 and each MP screened interval (MPA-5.5, MPB-5, and MPC-4.5) for a 37-hour period. Oxygen loss and other changes in soil gas composition over time were then measured at

TABLE 3.4 MAXIMUM PRESSURE RESPONSE AIR PERMEABILITY TEST BUILDING 457 AREA EAKER AFB, ARKANSAS

Location	Distance From VW1 (feet)	Screen Depth (feet bgs) a/	Elapsed Time to Maximum Pressure (minutes)	Maximum Pressure Response (inches of water)
MPA	5.5	5.5	120	1.40
MPB	13.7	5	120	0.32
MPC	24.5	4.5	120	0.05

^{a/} bgs = below ground surface.

TABLE 3.5 INFLUENCE OF AIR INJECTION AT VWs ON MONITORING POINT OXYGEN CONCENTRATIONS **BUILDING 457 AREA** EAKER AFB, ARKANSAS

Location	Distance From VW1 (feet)	Screen Depth (feet bgs) a/	Initial O ₂ b/ (%)	Final O ₂ ^{c/} (%)
MPA	5.5	5.5	5.1	20.4
MPB	13.7	5	2.2	8.2
MPC	24.5	4.5	2.2	6.6
TW1502	60.0	8-18	9.5 ^d /	4.7

bgs = below ground surface.
 Measurement taken prior to the respiration test and air injection at VWs.

Measurement taken following approximately 47 days of air injection at VWs.

d' Sample collected during the initial site visit on November 16, 1995.

these intervals. Oxygen, TVH, and carbon dioxide, were measured for a period of approximately 11 hours following air injection. The measured oxygen losses were then used to calculate biological oxygen utilization rates. The results of *in situ* respiration testing for VWs, MPA-5.5, MPB-5, and MPC-4.5 are presented in Figures 3.7 through 3.10, respectively. Table 3.6 provides a summary of the oxygen utilization and fuel degradation rates.

Oxygen losses measured at VW1 and each MP occurred at very high rates, ranging from 2.6 percent per hour at VW1 to 3.5 percent per hour at MPC-4.5. At MPC-4.5, the oxygen dropped from 20.6 percent to 0.0 percent in 10.5 hours. Based on the helium retention results obtained during the respiration testing at SS1 (Section 2.3.4), it is expected that the measured oxygen loss at B457 Area is the result of bacterial respiration and not due to diffusion away from the MPs.

Based on these oxygen utilization rates, an estimated 1,220 to 1,620 mg of fuel per kg of soil can be degraded each year at this site. This conservative estimate is based on an average air-filled porosity of approximately 0.01 liter per kg of soil, and a ratio of 3.5 mg of oxygen consumed for every 1 mg of fuel biodegraded. Actual degradation rates may be lower since the contaminant is a heavy hydrocarbon.

3.3.5 Potential Air Emissions

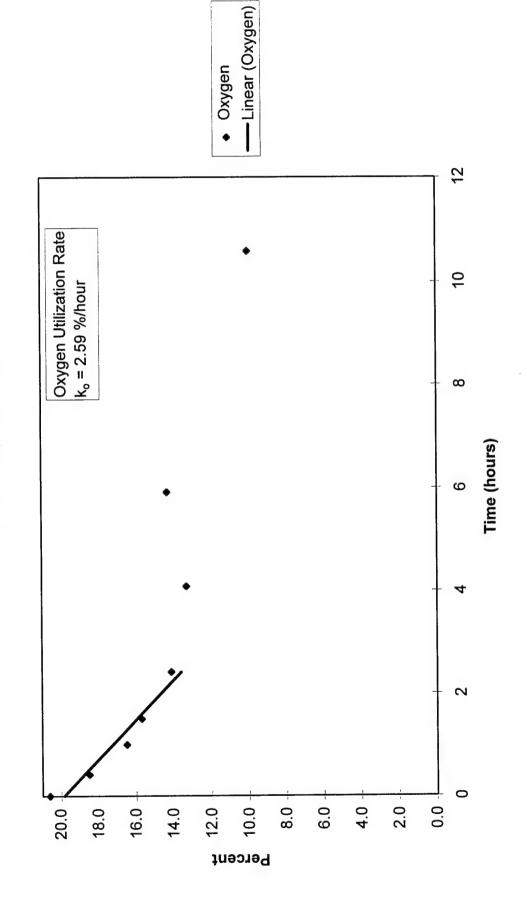
Soil gas concentrations of TVH compounds detected were less than 400 ppmv; however, the majority of contamination at B457 Area is shallow (between 4.5 and 7 feet bgs). Also, the VWs are located within 15 feet of the former tank excavation, which may provide a preferential air flow pathway. Consequently, the long-term potential for air emissions from full-scale bioventing operations at this site is considered moderate. VOC emissions should be minimal, however, because of the type and age of the site contaminants (greater than 5 years, and primarily fuel oil), and the low air injection rates (14.7 scfm per well), and because accumulated vapors will move slowly outward from the air injection points and will be biodegraded as they move horizontally through the soil. To confirm this, a GasTech® total hydrocarbon vapor analyzer will be used to monitor the breathing zone during the April 1997 field event. During pilot testing at B457 Area, health and safety monitoring of ambient air was not conducted because of windy conditions that would have provided biased results. Finally, the site is very isolated on Eaker AFB, and is located several thousand feet from any permanently occupied building.

3.4 Recommendations

Initial bioventing tests at this site indicate that oxygen has been depleted in the contaminated soils, and that air injection is an effective method of increasing aerobic fuel biodegradation. It is recommended that air injection continue at this site to determine the long-term radius of oxygen influence and the effects of time and available nutrients on fuel biodegradation rates.

A small, 1-horsepower regenerative blower has been installed at the site to continue air injection into VW1 and VW2 at a rate of approximately 14.7 scfm. The 1-year test period funded under Option 1 of the Extended Bioventing Project began on April 5,

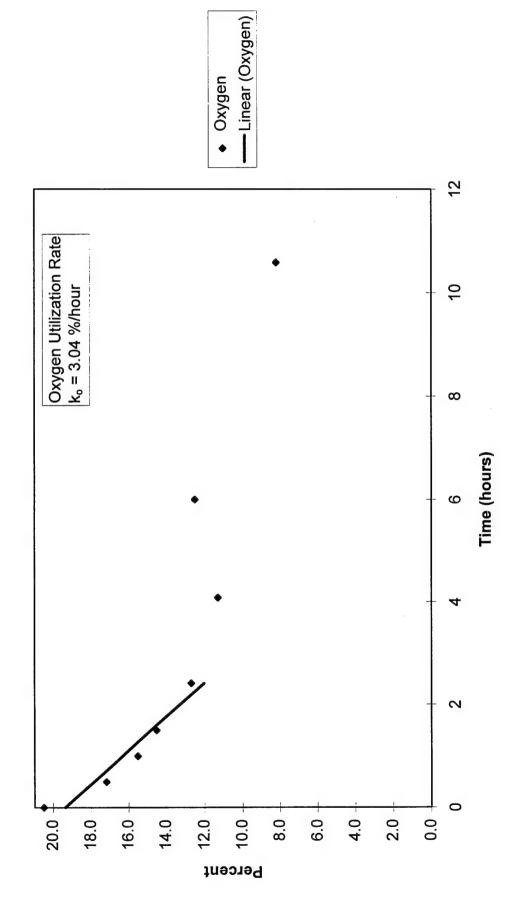
FIGURE 3.7
INITIAL RESPIRATION TEST RESULTS AT VW1
BUILDING 457 AREA
EAKER AFB, ARKANSAS



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FIGURE 3.8
INITIAL RESPIRATION TEST RESULTS AT MPA-5.5
BUILDING 457 AREA
EAKER AFB, ARKANSAS

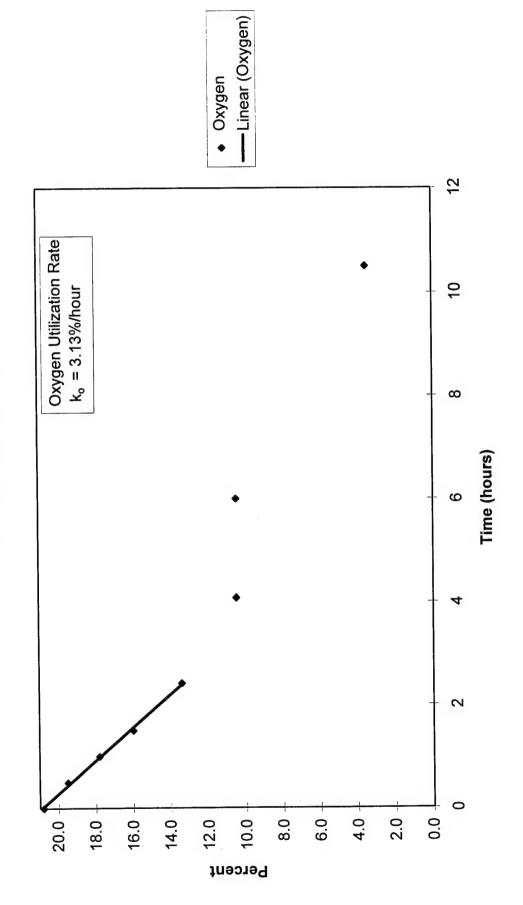


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MPA-5.5

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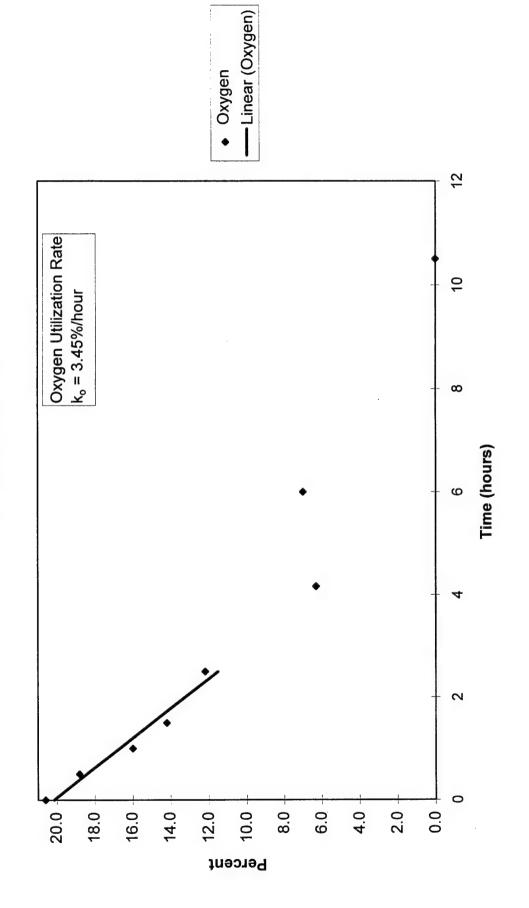
FIGURE 3.9
INITIAL RESPIRATION TEST RESULTS AT MPB-5
BUILDING 457 AREA
EAKER AFB, ARKANSAS



MPB-5

6/13/96

FIGURE 3.10
INITIAL RESPIRATION TEST RESULTS AT MPC-4.5
BUILDING 457 AREA
EAKER AFB, ARKANSAS



MPC-4.5

TABLE 3.6 OXYGEN UTILIZATION AND FUEL DEGRADATION RATES **BUILDING 457 AREA** EAKER AFB, ARKANSAS

Location- Depth (feet bgs) ^{a/}	Test Duration (hours)	0 ₂ Loss (%)	O ₂ Utilization Rate ^{b/} (%/hour)	Fuel Degradation Rate (mg TPH/kg/year) ^{c/}
VW1 5.5-15.5	2.4	6.5	2.59	1,220
MPA-5.5	2.4	7.8	3.04	1,430
MPB-5	2.4	7.4	3.13	1,470
MPC-4.5	2.4	8.4	3.45	1,620

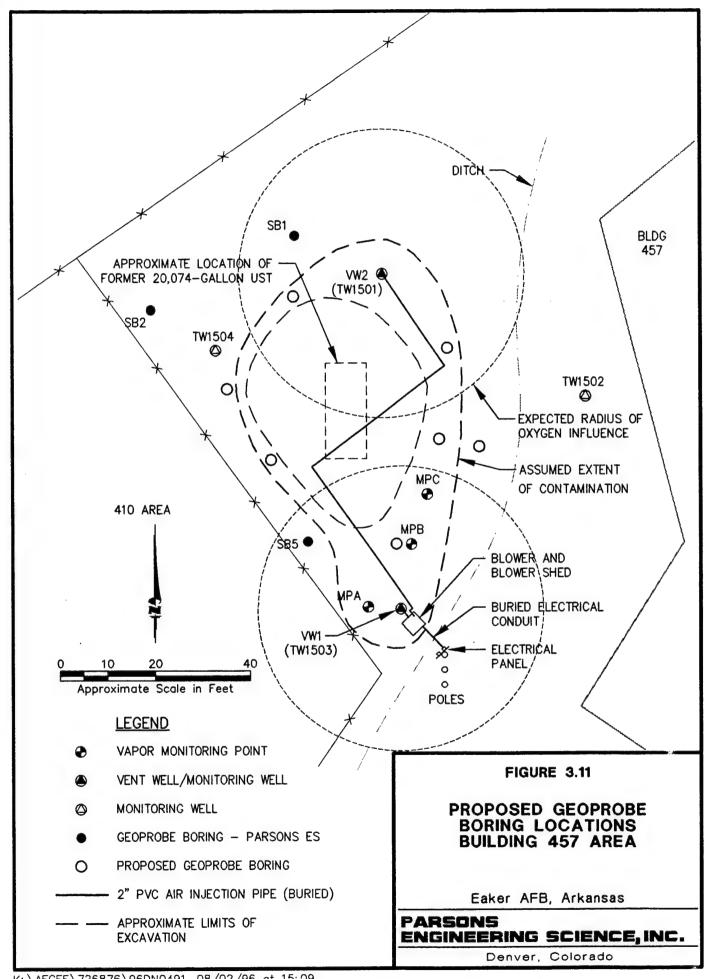
bgs = below ground surface.
 Values based on best-fit lines (Figures 3.7 through 3.10).
 mg TPH/kg/year = milligrams of total petroleum hydrocarbons per kilogram of soil per year.

1996. Parsons ES will operate the blower through April 7, 1997, conduct radius of oxygen influence measurements on April 7, 1997, shut off the blower, and then conduct follow-up "area" respiration tests. Approximately 1 month later (May 1997), Parsons ES will mobilize the Geoprobe® rig to the site to perform additional soil sampling and MP installation (if necessary). Figure 3.11 shows the proposed additional Geoprobe® boring and possible MP locations at B457 Area. In addition, during the May 1997 field event, Parsons ES will collect soil gas samples from the three MPs that were sampled during the initial sampling event (Table 3.2) to determine the levels of cleanup achieved after 1 year of *in situ* treatment.

The current bioventing pilot-scale system appears to be treating most of the vadose zone contamination at B457 Area; however, one or two more VWs may be required to treat the entire volume of contaminated soil. Considering that limited soil analytical data are available, areas outside the current area of venting influence may have some residual vadose zone and smear zone contamination. During the May 1997 field event, Parsons ES will install approximately seven more Geoprobe® borings to further define the FAE of contamination and to determine whether or not additional VWs will be necessary (Figure 3.11). Borings that exhibit soil contamination will be converted into vapor MPs. Additional MPs will be installed and constructed in the same manner as MPA, MPB, and MPC, except a thermocouple will be installed in one MP. borings will be placed near the eastern edge of the former tank excavation to determine whether of not an additional VW will be required in that area. If contamination is observed at the boring near monitoring well TW1504, it will be recommended that the well be converted to a VW. A soil sample collected adjacent to MPB at a depth of 5 feet bgs will be used to document contaminant reduction in soils. All soil sampling activities will be conducted under the assumption that sampling results will eventually be used to obtain site closure. Approximately six soil samples will be analyzed for TEPH by EPA Method SW8015M.

Results of the initial air permeability test indicate that the radius of oxygen influence exceeds 25 feet. Oxygen influence measurements taken at the end of 1 year of system operation will be used to determine the actual radius of influence and to assess the need for additional VWs. Soil gas measurements taken at the end of 1 year of system operation will be used to confirm contaminant reduction.

Based on the oxygen influence observed following 46 days of air injection during the "wet" season, it is anticipated that the shallow groundwater at B457 Area will not significantly limit the radius of oxygen influence. However, it should be noted that the bioventing technology will not treat the contaminated soils below the groundwater table. Soil sampling conducted during tank removal activities indicated that petroleum-contaminated soils were present at depths to 12 feet bgs (Ogden, 1995). Considering that the groundwater table fluctuates at depths of 9 to 11 feet bgs, some of the contaminated soil will remain untreated. Therefore, an eventual risk-based approach to site closure is recommended for B457 Area. Except for xylenes, none of the BTEX constituents were detected in soil, and groundwater analytical results from downgradient monitoring wells suggest that dissolved petroleum hydrocarbon contaminants have not migrated more than 20 feet beyond the edge of the former tank excavation (US Air Force, 1995). The potential for off-Base migration of contaminated groundwater from the B457 Area is considered to be very low.



Therefore, the potential for downgradient receptors to be exposed to contaminated groundwater is low, because contaminant migration appears to be minimal. It is likely that intrinsic bioremediation processes coupled with active remediation (bioventing) will continue to reduce hydrocarbon concentrations in soil and groundwater at the site. As the vadose zone is bioremediated via bioventing, contaminant loading (leaching and dissolution) into the groundwater will be reduced significantly, thereby further reducing any potential threat to human health and the environment.

4.0 PILOT TEST RESULTS - UST 702

The source of soil contamination at this site was the former 2,010-gallon UST 702, which was used to store fuel oil. The tank, along with a majority of the grossly contaminated soils, has been removed (Ogden, 1995)

4.1 Pilot Test Design and Construction

An initial bioventing pilot test was performed by Parsons ES at UST 702 during the period from March 18 through April 5, 1996. A total of 12 Geoprobe® boreholes were drilled at the site to better define the extent of the vadose zone contamination, and to determine appropriate vapor MP screen depths and locations and optimal VW placement. Because the petroleum contamination at UST 702 is highly localized, existing monitoring well TW1601 is being used as the VW for air injection. Installation of three single-depth vapor MPs took place on March 21, 1996. The MPs were installed in Geoprobe® boreholes. Electrical services were provided by Cache Valley Electric of Blytheville, Arkansas.

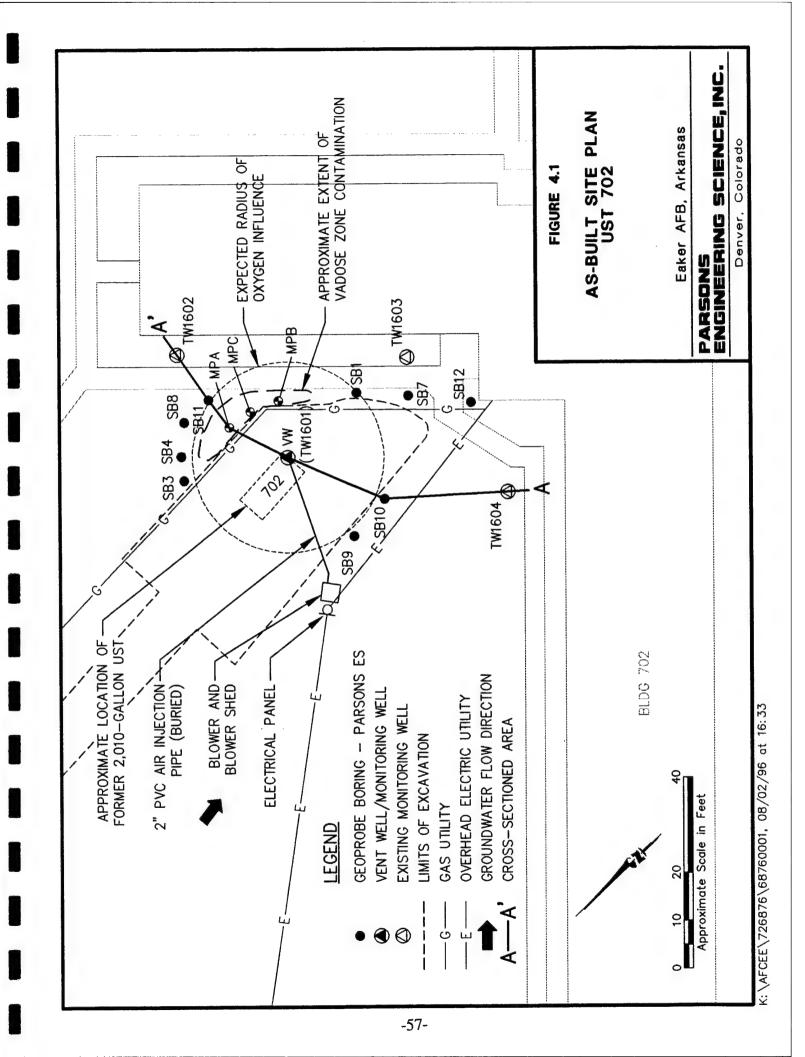
Three MPs, a blower unit, and air injection piping to one monitoring well were installed at the UST 702 site. Figure 4.1 is a site layout showing the locations of the VW, MPs, blower unit, and existing groundwater monitoring wells at the site. The hydrogeology of the site is depicted on the cross-section on Figure 4.2. Boring logs for the Geoprobe® boreholes, MPs and VW are included in Appendix A. The background MP for this site was the existing groundwater monitoring well MW10 described earlier (also see Section 4.1.2), which is screened several feet above the groundwater surface. The following sections describe the final design and installation of the bioventing system at UST 702.

4.1.1 Air Injection Vent Well

Existing temporary groundwater monitoring well TW1601 is being used as the VW at UST 702. The well was installed in oxygen-deficient soils in the center of the tank excavation. The VW is constructed of 2-inch-diameter, schedule 40 PVC casing and slotted PVC screen. Table 4.1 summarizes the VW construction details. Details of the VW construction are presented on Figure 4.3.

4.1.2 Monitoring Points

The single-depth MP screens were installed at the depths listed on Table 4.1. The three MPs (MPA, MPB, and MPC) at this site were constructed as shown in Figure 4.4. Each MP, installed in a Geoprobe® boring, was constructed with a 6-inch-long,



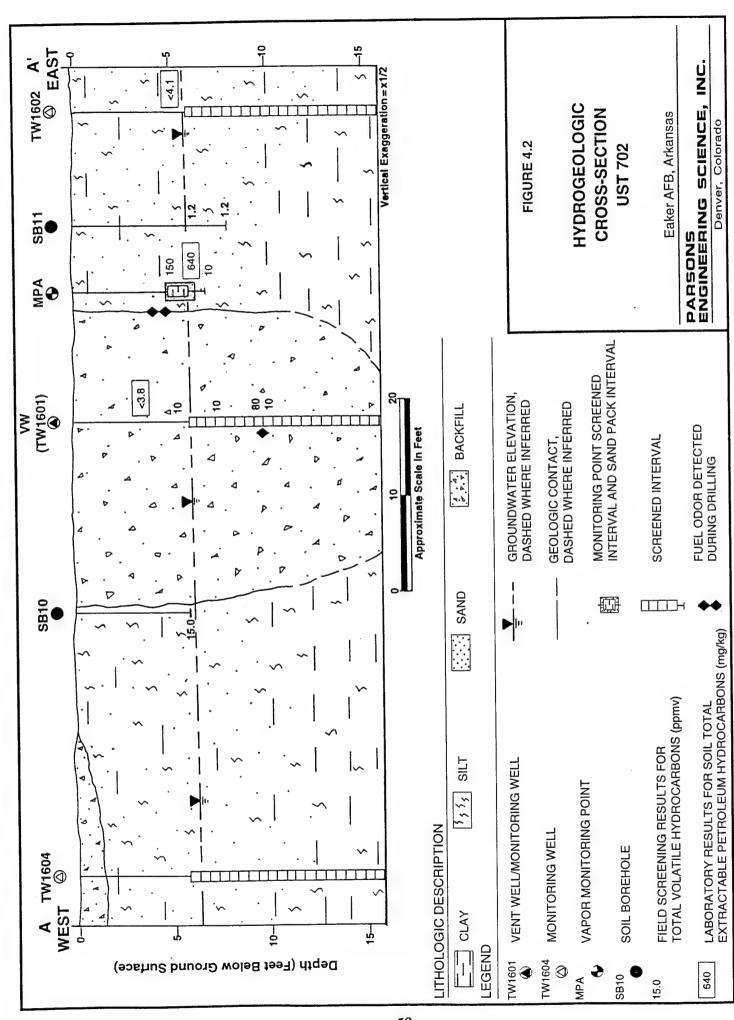
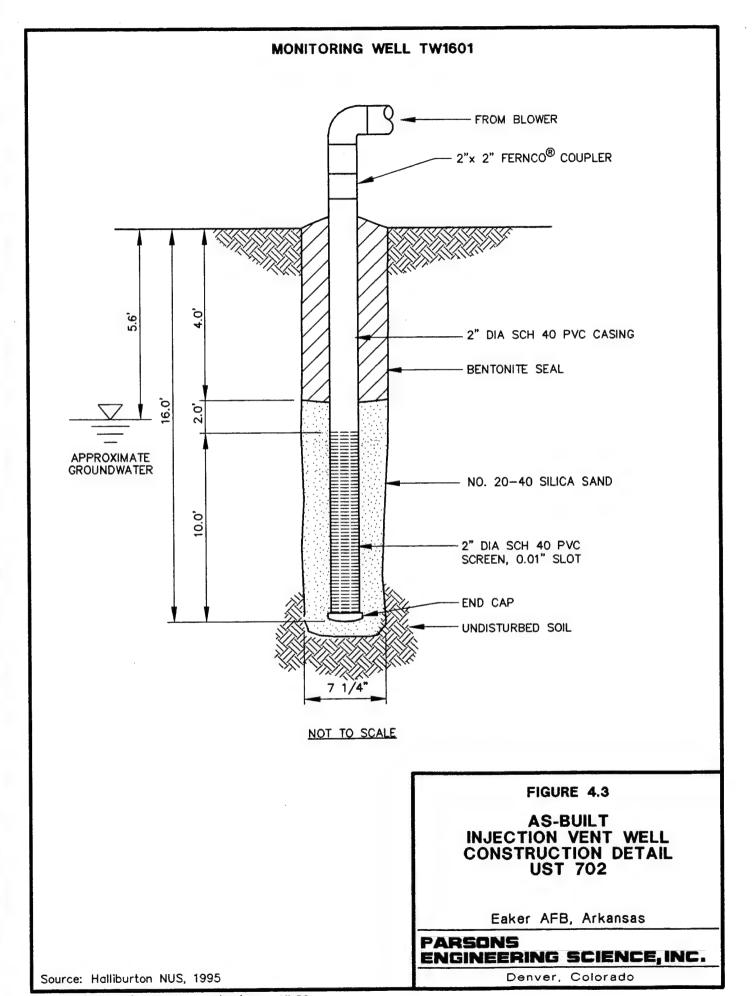


TABLE 4.1 VENT WELL AND MONITORING POINT CONSTRUCTION SUMMARY BUILDING 702 EAKER AFB, ARKANSAS

Location	Total Borehole Depth (feet bgs) a	Screened Interval (feet bgs)
VW1 (TW1601)	16	6-16
MPA	7	5.5
MPB	6	5
MPC	6	4.5

bgs = below ground surface.

Note: The monitoring points were completed on March 21, 1996.



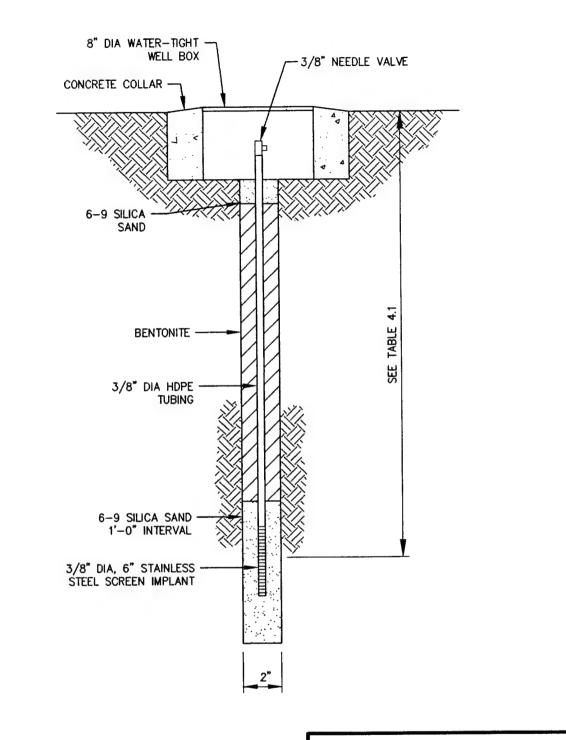


FIGURE 4.4

AS-BUILT
MONITORING POINT
CONSTRUCTION DETAIL
UST 702
(TYPICAL)

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

0.25-inch, OD stainless steel screen implant attached to 0.5-inch-OD, HDPE tubing that extends to the ground surface. The top of each 0.5-inch HDPE riser was completed with a 3/8-inch needle valve. The top of each MP was completed with a flush-mounted metal well protector set in concrete.

The existing groundwater monitoring well MW10, was used as the background MP for this pilot test. MW10 is located in an uncontaminated area approximately 4,500 feet southeast of UST 702 and has a screened interval extending above the groundwater surface.

4.1.3 Blower Unit

A 1-horsepower Gast® regenerative blower unit was used for the initial pilot test and was installed for extended testing. The blower is energized by 230-volt, three-phase, 30-amp line power from a new distribution panel located on a new electrical panel installed on the power pole adjacent to the blower shed (Figure 4.1). The pilot test blower injected air into the subsurface at 15.8 scfm for the initial test at the VW. Once the groundwater surface drops, the injection flow rate for the VW will be re-optimized for the extended pilot test. It is anticipated that the system re-optimization will be completed in August 1996. The final blower wiring was completed, and the system was started on April 5, 1996. The configuration, instrumentation, and specifications for the initial pilot test and extended pilot test units are shown on Figure 4.5. Following the field mobilization, Parsons ES engineers provided an O&M briefing checklist and blower maintenance manual to AFBCA personnel. A copy of the checklist is provided in Appendix C.

With one VW manifolded to the blower system, the majority of the identified vadose zone soil contamination should be within the anticipated treatment area. However, the 1.0-horsepower blower system has sufficient reserve air-flow capacity to provide air to more than one VW should Eaker AFBCA decide to use the blower at another site in the future. Currently, excess air flow is being bled off using the manual gate valve (Figure 4.5).

4.2 Pilot Test Soil and Soil Gas Sampling Results

4.2.1 Sampling Results

Soils at this site consist generally of approximately 9 to 10 feet of sandy silt overlying clay (Figure 4.2). Groundwater was measured in the VW at a depth of approximately 5.6 feet bgs prior to air injection. More detailed geological information regarding UST 702 can be found in the geological cross-section (Figure 4.2) and the geologic boring logs (Appendix A).

Significantly petroleum-hydrocarbon-contaminated soils at this site were encountered only at one discrete interval in MPB. A black "tar-like" soil sample collected from a depth of 5.5 feet bgs from MPB contained 4,200 mg/kg of TEPH. Much lower levels of TEPH were detected at MPA and MPC, and total BTEX concentrations were very low at all three locations. Contaminated soils were identified based on odor, staining, and headspace VOC field screening results.

LEGEND

- (1) INLET AIR FILTER SOLBERG F-30P-150
- (2) VACUUM GAUGE (IN H2O)
- \bigcirc BLOWER GAST $^{\odot}$ 1.0HP R4310P-50
- (4) MANUAL PRESSURE RELIEF (BLEED) VALVE 1 1/2" GATE
- (5) AUTOMATIC PRESSURE RELIEF VALVE
- (6) TEMPERATURE GAUGE (F)
- (7) PRESSURE GAUGE (IN H2O)

BLOWER

FROM ATMOSPHERE

- (8) FLOW CONTROL VALVE 1 1/2" GATE
- (9) FLOW MEASURING PORT FITTED WITH PLUG
- (10) STARTER

⊚

(1) BREAKER BOX - 230V/THREE PHASE/40 AMP

NO SCALE

AS-BUILT BLOWER SYSTEM INSTRUMENTATION DIAGRAM FOR AIR INJECTION UST 702

Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

(109 IML)

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AIR FILTER Soil samples for laboratory analysis were collected from Geoprobe® polybutyrate liners. Soil sample headspace was screened for VOCs using a PID to determine the presence of contamination and to select soil samples for laboratory analysis. Soil samples for laboratory analysis were collected at 5.5 feet bgs from MPB and MPC boreholes, and at 6.5 feet bgs from MPA. A background soil sample was collected from an apparently uncontaminated area near MW10. Soil samples were shipped via Federal Express® to Evergreen Analytical Laboratory in Wheat Ridge, Colorado for chemical and physical analysis. Soil samples were analyzed for TEPH by EPA Method SW8015 (modified) and for BTEX by EPA Method SW8020. Three samples were also analyzed for iron, alkalinity, TKN, and several physical parameters. The background soil sample was analyzed only for TKN. Copies of the chain-of-custody forms are included in Appendix A. The results of these analyses are provided in Table 4.2.

One soil gas sample for laboratory analysis was collected prior to performing the *in situ* respiration test in a laboratory-provided, evacuated, 1-liter SUMMA[®] canister. The sample was collected by extracting soil gas from MPB-5. MPB is the only location where oxygen levels were depleted, therefore, only one soil gas sample was collected at the site. The soil gas sample was collected following procedures in the protocol document (Hinchee *et al*, 1992). The soil gas sample was shipped via Federal Express[®] to Air Toxics, Inc. in Folsom, California for TVH and BTEX analysis using EPA Method TO-3. The results of these analyses are provided in Table 4.2.

4.2.2 Exceptions to Test Protocol Document Procedures and Work Plan

Procedures described in the protocol document (Hinchee et al., 1992) were used to complete pilot tests at UST 702. The only exceptions were that thermocouples were not installed in the MPs, and helium was not used during the respiration testing. Because the groundwater is very shallow, it was necessary to perform an "area" respiration test; therefore, helium was not used.

Because most of the contaminated soil was removed during tank removal activities, a limited area of contamination remains adjacent to the former tank excavation. Because existing monitoring well TW1601 is near the localized extent of contamination, this well was used as a VW. Therefore, a VW was not installed as proposed in the work plan. Because the contamination is so shallow and localized, only one soil gas sample and three soil samples were collected.

4.3 Pilot Test Results

4.3.1 Initial Soil Gas Chemistry

Prior to initiating any air injection, soil gas in the VW (TW1601), all MPs, and three other existing groundwater monitoring wells (TW1602 through TW1604, see Figure 4.1) was analyzed for initial oxygen, carbon dioxide, and TVH concentrations using portable gas analyzers, as described in the technical protocol document (Hinchee et al., 1992). Table 4.3 summarizes the initial soil gas chemistry. The VW, MPs, and MWs were purged until oxygen levels had stabilized to remove stagnant gas prior to collecting soil gas samples.

TABLE 4.2 SOIL AND SOIL GAS ANALYTICAL RESULTS UST 702 EAKER AFB, ARKANSAS

Analyte (Units) ^{a/}	Sample Location-Depth (feet below ground surface)			
Soil Gas Hydrocarbons TVH ^{b'} (ppmv) Benzene (ppmv) Ethylbenzene (ppmv) Toluene (ppmv) Xylenes (ppmv)	MPB-5 48 0.020 0.12 0.12 22			
Soil Hydrocarbons TEPH - diesel (mg/kg) Benzene (μg/kg) Toluene (μg/kg) Ethylbenzene (μg/kg) Xylenes (μg/kg)	MPA-6.5 640 < 2.3 < 2.3 6.5 25	MPB-5.5 4,200 < 57 < 57 560 750	MPC-5.5 370 < 2.2 < 2.2 41 67	
Soil Inorganics pH (pH units) Iron (mg/kg) Alkalinity (mg/kg) TKN (mg/kg) Phosphorus (mg/kg)	MPA-4 5.8 12,000 55.5 151 < 2.1	MPA-5.5 6.0 17,300 < 27.8 180 <2.2	MPC-4 5.8 14,800 < 27.8 147 < 2.1	BG-2.5 a' < 4.6
Soil Physical Parameters Moisture (% wt.) Gravel (%) Sand (%) Fines (Silt and Clay) (%)	MPA-4 9.9 0.0 44.0 66.0	MPA-5.5 10.3 0.0 16.0 84.0	MPC-4 10.3 0.0 18.4 81.6	

a/ ppmv=parts per million, volume per volume; mg/kg=milligrams per kilogram; µg/kg=micrograms per kilogram; TKN=total Kjeldahl nitrogen; TVH=total volatile hydrocarbons; TEPH=total extractable petroleum hydrocarbons; wt.=weight.

b/ TVH referenced as jet fuel (molecular weight=156) and analyzed by USEPA Method TO-3.

c/ TEPH analyzed for by USEPA Method SW8015 modified.

d/ --- = Not analyzed.

TABLE 4.3 INITIAL SOIL GAS CHEMISTRY BUILDING 702 EAKER AFB, ARKANSAS

	C			Field	Laboratory
Sample Location	Screen Depth (feet)	O ₂ (%)	CO ₂ (%)	TVH (ppmv)*	TVH (ppmv) b/
VW1 (TW1601)	6-16	1.14	11.0°	88°	d/
MPA	5.5	20.8	0.05	30	
MPB	5	5.5	12.2	510	48
MPC	4.5	20.8	0.05	18	
TW1602	6-16	20.8	0.08	10	
TW1603	6-16	20.8	0.08	13	
TW1604	6-16	20.8	0.08	10	da da 500

Total volatile hydrocarbon field screening results reported in parts per million, volume per volume.

Laboratory total volatile hydrocarbon analytical results referenced to jet fuel (molecular weight=156).

--- = Not analyzed.

The screened interval was below groundwater; therefore, the soil gas chemistry observed during the November 16, 1995 site visit is presented.

At the VW and MPB, soil gas oxygen concentrations were below the atmospheric concentration of approximately 21 percent. Depleted oxygen concentrations indicate significant biological activity and soil contamination. Sampling results strongly indicate significant soil contamination at the 5-foot depth of MPB. An oxygen concentration of 5.5 percent at this location corresponds with a total BTEX concentration of 1.4 mg/kg in the soil. These results clearly indicate significant biological activity associated with contaminated soils. Initial oxygen concentrations at monitoring wells TW1602, TW1603, and TW1604, and at monitoring points MPA and MPC, were at 20.8 percent. These higher soil gas oxygen concentrations coupled with lower soil gas TVH concentrations indicate the absence of significant fuel contamination at these locations. The vadose zone contamination at UST 702 appears to be confined to a small area east of the former tank excavation (Figure 4.1).

TVH field measurements at the VW and MPs ranged from 10 to 510 ppmv, and the soil gas laboratory TVH result for MPB-5 was 48 ppmv (Table 4.3). Because of the limited extent of the contamination at UST 702, only one soil gas sample was collected for laboratory analysis.

4.3.2 Air Permeability

An air permeability test was conducted according to protocol document procedures. Air was injected into the VW for 15 hours at a rate of approximately 11 scfm and an average pressure of 36 inches of water. The maximum pressure response at each MP is listed in Table 4.4. The pressure measured at the MPs increased rapidly during the first 5 minutes of the test, then decreased for the remainder of the test. Due to the rapid pressure response, the steady-state method of determining air permeability was selected. A soil gas permeability value of approximately 10 darcys, typical for sandy, silty clay soil, was calculated for this site. A radius of pressure influence of at least 10 feet was observed. At MPB, the closest measuring point from the VW at a distance of 10 feet, the maximum pressure response was 0.46 inch of water. At MPA and MPC a slight vacuum response was observed, however this phenomena is likely the result of barometric pressure. Because of the shallow groundwater at the site during pilot testing, results obtained during the permeability test do not represent the conditions that are expected throughout the drier seasons of the year.

4.3.3 Oxygen Influence

The radius of oxygen increase in the subsurface resulting from air injection into the VW during pilot testing is the primary design parameter for full-scale bioventing system design. Optimization of full-scale and multiple VW systems require pilot testing to determine the volume of soil that can be oxygenated at a given flow rate and VW screen configuration.

Table 4.5 presents the changes in soil gas oxygen levels that occurred during a 46-day injection period using the extended pilot test blower unit. This period of air injection produced an increase in soil gas oxygen at MPB-5, the only oxygen-deficient monitoring point. Based on measured changes in oxygen levels, it is anticipated that the radius of influence for a long-term bioventing system at this site will exceed 15 feet

TABLE 4.4 MAXIMUM PRESSURE RESPONSE AIR PERMEABILITY TEST **BUILDING 702** EAKER AFB, ARKANSAS

Location	Distance From VW1 (feet)	Screen Depth (feet bgs) a/	Elapsed Time to Maximum Pressure (minutes)	Maximum Pressure Response (inches of water)
MPA	13.4	5.5	910	-0.01 ^{b/}
MPB	10.4	5	910	0.46
MPC	14.5	4.5	910	-0.015 ^{b/}

bgs = below ground surface.A negative pressure was observed.

TABLE 4.5 INFLUENCE OF AIR INJECTION AT VW ON MONITORING POINT OXYGEN CONCENTRATIONS **UST 702** EAKER AFB, ARKANSAS

Location	Distance From VW (feet)	Screen Depth (feet bgs) ^{a/}	Initial O ₂ b/ (%)	Final O ₂ °' (%)
MPB	10.4	5	5.5	16.5

bgs = below ground surface.
 Measurement taken prior to the respiration test and air injection at the VW.
 Measurement taken following approximately 46 days of air injection at the VW.

at all depths. Monitoring during the extended pilot test at this site will better define the effective treatment radius.

4.3.4 In Situ Respiration Rates

The *in situ* "area" respiration test was performed by injecting air (oxygen) into the VW using the extended blower for a 41-hour period. Oxygen loss and other changes in soil gas composition over time were then measured at the VW and MPB-5. Initial soil gas data indicated that MPA-5.5 and MPC-4.5 were not oxygen deficient (Table 4.3); therefore, a respiration test was not conducted at these MPs. Oxygen, TVH, and carbon dioxide were measured for a period of approximately 34 hours following air injection. The measured oxygen losses were then used to calculate biological oxygen utilization rates. The results of *in situ* respiration testing for MPB-5 is presented in Figure 4.6. Table 4.6 provides a summary of the oxygen utilization and fuel degradation rates at this MP and at the VW.

Oxygen loss measured at MPB and the VW occurred at moderate rates, ranging from 0.56 percent per hour at MPB-5 to 0.67 percent per hour at the VW. At MPB-5, the oxygen level dropped from 19.4 percent to 12.8 percent in 34 hours. Following air injection, the groundwater level at the VW recovered rapidly, so only three soil gas samples were obtained prior to the screen being submerged under groundwater. Therefore, because few data were obtained from the VW, respiration results are only qualitative.

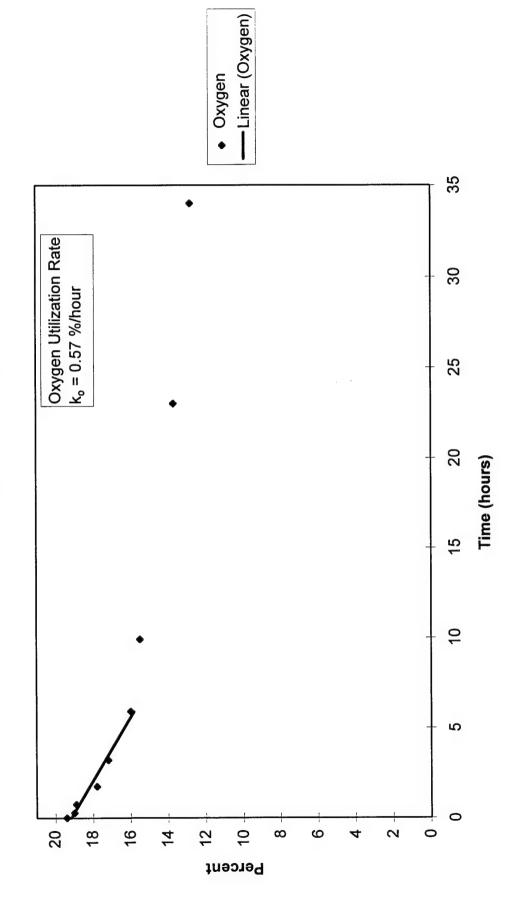
Based on these oxygen utilization rates, an estimated 990 to 1,160 mg of fuel per kg of soil can be degraded each year at this site. This conservative estimate is based on an average air-filled porosity of approximately 0.05 liter per kg of soil, and a ratio of 3.5 mg of oxygen consumed for every 1 mg of fuel biodegraded. Actual degradation rates may be slower if air flow is significantly limited by shallow groundwater conditions.

4.3.5 Potential Air Emissions

Soil concentrations of total BTEX compounds detected were less than 1.4 mg/kg; however, the majority of vadose zone contamination at UST 702 is shallow (located between 5 and 7 feet bgs). Consequently, the long-term potential for air emissions from full-scale bioventing operations at this site is considered moderate. VOC emissions should be minimal, however, because of the type and age of the site contaminants (greater than 5 years, and primarily fuel oil); the low air injection rate (11 scfm), and the localized nature of the contamination, and because vapors will move slowly outward from the air injection point and will be biodegraded as they move horizontally through the soil. To confirm this, a GasTech® total hydrocarbon vapor analyzer will be used to monitor the breathing zone during the April 1997 field event. During pilot testing at UST 702, health and safety monitoring of ambient air was not conducted because of windy conditions that would have provided biased results. Finally, the site is located next to Building 702, which is currently unoccupied and is expected to remain so until the bioventing system is dismantled.

6/14/96

FIGURE 4.6
INITIAL RESPIRATION TEST RESULTS AT MPB-5
UST 702
EAKER AFB, ARKANSAS



MPB-5

TABLE 4.6 OXYGEN UTILIZATION AND FUEL DEGRADATION RATES **UST 702** EAKER AFB, ARKANSAS

Location- Depth (feet bgs) a/	Test Duration (hours)	0 ₂ Loss (%)	O ₂ Utilization Rate ^{b/} (%/hour)	Fuel Degradation Rate (mg TPH/kg/year) ^{c/}
VW 6-16	1.1	$0.8^{d/}$	0.67	1,160
MPB-5	5.9	3.4	0.57	990

bgs = below ground surface.
 Value based on best-fit line (See Figure 4.6 for MPB-5).

mg TPH/kg/year = milligrams of total petroleum hydrocarbons per kilogram of soil per year d' Groundwater recovered to above the VW screened interval approximately 1 hour after oxygenation with the regenerative blower.

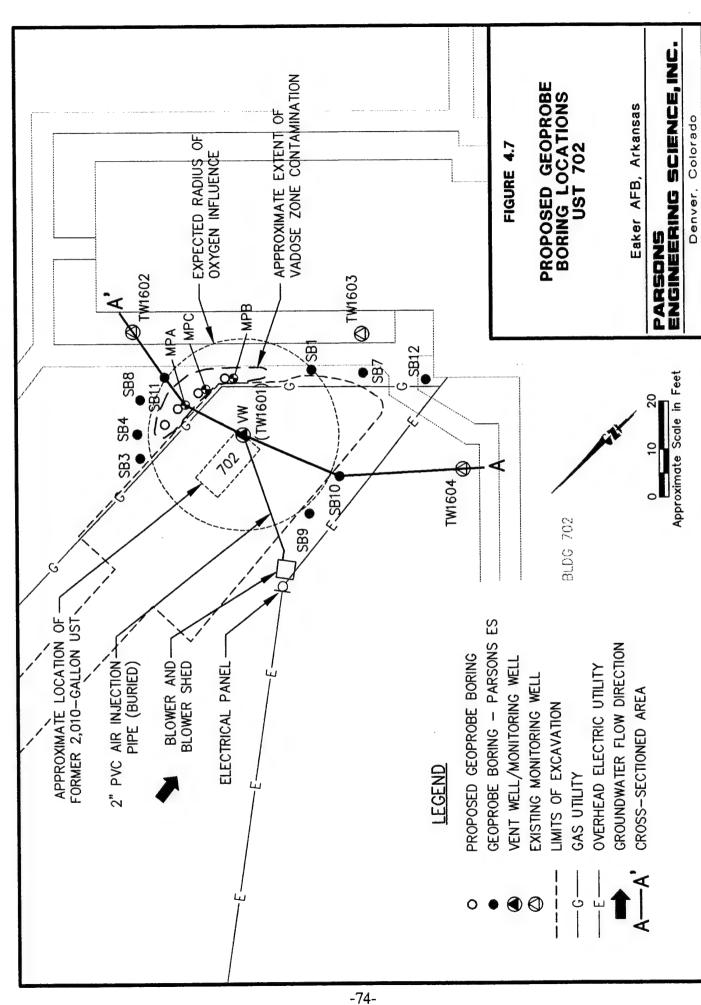
4.4 Recommendations

Initial bioventing tests at this site indicate that oxygen has been depleted in the remaining area of localized soil contamination near MPB, and that air injection is an effective method of increasing aerobic fuel biodegradation. It is recommended that air injection continue at this site to determine the long-term radius of oxygen influence and the effects of time and available nutrients on fuel biodegradation rates.

A small, 1-horsepower regenerative blower has been installed at the site to continue air injection at a rate of approximately 11 scfm. The 1-year test period funded under Option 1 of the Extended Bioventing Project began on April 5, 1996. Parsons ES will operate the blower through April 7, 1997, conduct radius of oxygen influence measurements on April 7, 1997, shut off the blower, and then conduct follow-up "area" respiration tests at the VW and MPB-5. Approximately 1 month later (May 1997) Parsons ES will mobilize the Geoprobe® rig to the site to perform additional soil sampling. Figure 4.7 shows the proposed additional Geoprobe® boring locations at UST 702. One soil sample from each of four soil borings will be analyzed for TEPH by USEPA Method SW8015M. All soil sampling activities will be conducted under the assumption that sampling results will eventually be used to obtain site closure. In addition, during the May 1997 field event, Parsons ES will collect a soil gas sample from MPB-5 to determine the level of cleanup achieved after 1 year of in situ treatment.

Results of the initial air permeability test indicate that the radius of oxygen influence exceeds 10 feet at a depth of 5 feet bgs. This, in conjunction with the localized extent of the majority of contamination (near MPB), and the placement of the VW (TW1601) near the eastern edge of the former tank excavation, is evidence that the entire volume of contaminated soil is receiving bioventing treatment. Therefore, the current bioventing pilot-scale system appears to be adequate to treat the entire volume of fuel-contaminated soil, and additional air injection points will not be necessary.

Based on the oxygen influence observed following 46 days of air injection during the "wet" season, it is anticipated that the shallow groundwater at the UST 702 site will not significantly limit the radius of oxygen influence. However, it should be noted that the bioventing technology will not treat the contaminated soils below the groundwater table. Soil sampling conducted during tank removal activities indicated that petroleumcontaminated soils were present to a depth of 17 feet bgs. Considering that the groundwater fluctuates at depths of 5 to 9 feet bgs, much of the contaminated soil will remain untreated. Therefore, an eventual risk-based site closure is recommended for Benzene concentrations were non-detectable in soil (Table 4.2), and groundwater analytical results from downgradient monitoring wells suggest that dissolved petroleum hydrocarbon contaminants have not migrated more than 20 feet beyond the edge of the former tank excavation. The potential for off-Base migration of contaminated groundwater from the UST 702 site is considered to be very low. Therefore, the potential for downgradient receptors to be exposed to contaminants in groundwater is low, because contaminant migration appears to be minimal. It is likely that intrinsic bioremediation processes coupled with active remediation (bioventing) will continue to reduce hydrocarbon concentrations in soil and groundwater at the site.



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5.0 PROJECT SCHEDULE

The following schedule is contingent upon approval of the proposed additional field work. It is assumed that digging permits that were obtained for the initial pilot tests will be valid for the proposed borings at each site.

<u>Date</u>
April 7, 1997
April 7-10, 1996
May 5-10, 1996
May 10, 1996
May 10, 1996
July 11, 1996

6.0 REFERENCES

- Hinchee, R.E., S.K. Ong., R.N. Miller, D.C. Downey, and R. Frandt. 1992. Test Plan and Technical Protocol for a Field Treatability Test for Bioventing. Prepared for USAF Center for Environmental Excellence. May.
- Halliburton NUS (HNUS). 1992. Technical Memorandum (Step 2) for the Remedial Investigation/Feasibility Study, Eaker AFB, Arkansas
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- HNUS. 1995. Unpublished boring logs and well construction diagrams, Eaker AFB, Arkansas
- Ogden Environmental and Energy Service. 1995. Tank Removal Reports, Eaker AFB, Arkansas.
- Parsons Engineering Science, Inc. 1996. Draft Bioventing Pilot Test Work Plan for Spill Site No. 1, Building 457 Area, and UST 702, Eaker AFB, Arkansas. February.
- US Air Force. 1995. Unpublished site history and data, Eaker AFB, Arkansas.

APPENDIX A
GEOLOGIC BORING LOGS,
CHAIN-OF-CUSTODY FORMS,
TEST DATA, AND CALCULATIONS

JOB NUMBER .: SITE:

BORING NUMBER: RIG TYPE:

TEMPERATURE (°F): COMMENTS:

7268	76.6	8130)
Spill	Site	No.	1

~ 40°F

SSI-SBI(VWI) WEATHER:

CLIENT:	
BORING DIA.	:
CONTRACTO	Ţ

DRLG MED:

AFCEE/Eaker AFB Parsons ES

DATE: ELEVATION: DATUM:

G - Grab Sample

GEOLOGIST: D. Teets

				Split	Laboratory			
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PID - Photoionization Detector

BH - Borehole

SAA - Same As Above Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

JOB NUMBER.: SITE:

BORING NUMBER:

RIG TYPE: TEMPERATURE (°F):

COMMENTS:

7268	76.6	8130)
C=:11	Cita	NIO	1

Spill Site No. 1 SS1-WWZ

CLIENT: BORING DI

DRLG MED:

CLIENT:	- 2
BORING DIA.:	
CONTRACTOR:	
WEATHER:	_

AFCEE/Eaker AFB	
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DATE: **ELEVATION:** DATUM:

G - Grab Sample

D. Teets GEOLOGIST:

				Split	Laboratory			
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(ft.)	file	0000	Geologic Description	Interval	Identification	Type	ppmv	
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PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

DATE: AFCEE/Eaker AFB CLIENT: 726876.68130 JOB NUMBER .: ELEVATION: BORING DIA .: Spill Site No. 1 SITE: DATUM: CONTRACTOR: BORING NUMBER: 55-VW3 D. Teets GEOLOGIST: WEATHER: Auger Rig RIG TYPE: DRLG MED: TEMPERATURE (°F):

Mobile B53

Depth		USCS	Coologie Description	Split Spoon	Laboratory Sample	Sample Type	PID	Remarks
(ft.) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	file (650)	Dar	Geologic Description (o-8 Clay fasty sms.lt, hrn lgrey / iron 0xide stsining, dense, moist, no oder. 9 to 18-9. 5 Clay tr silt, brn, moist, sm blk staining, iron oxide staining, sl oder Fat clay 9.5-10: 5: It + clay, hrm tgray, sl iron oxide staining, pet, oder, moist 10-12: 5: It clayer, gray, strong pet oder, moist 17-13: SAA 13-14: SAA except squarter	Interval	Identification	Туре	ppmv	e 10'f/D 479/1.2 e 10'f/D 479/1.2 e 12'pid = 62.1/1.1 e13 Pid=477/1.8

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger

HSA - Hollow Stem Auger ft - Feet bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample BS - Brass Sleeve Sample

					1 /	
JOB NUMBER.:	726876.68130	CLIENT:	AFCEE/Eaker AFB	DATE:	3/22/96	_
SITE:	Spill Site No. 1	BORING DIA.:		ELEVATION:	•	
BORING NUMBER:	551-VW4	CONTRACTOR:		DATUM:	,	
RIG TYPE:	1	WEATHER:		GEOLOGIST:	D. Teets	
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					Split	-Laboratory			
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	(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
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H	13			SI Mk staining, V maist, Strong oder		75-044 - 124		213	PID=195/1.5
•	13			19 Si A class grad wet strong oder	X			e14	PID=195/1.5 PID=260/1.8
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PID - Photoionization Detector

BH - Borehole

ft - Feet

COMMENTS:

SAA - Same As Above Bkgrnd - Background

HSA - Hollow Stem Auger

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample BS - Brass Sleeve Sample

			•		GE	OLO	GIC BOI	RING L	0)G			1 /
JOB NUMBER.: SITE: BORING NUMBER: RIG TYPE: TEMPERATURE (°F): COMMENTS:		BER:	Spill Site No. 1 BORING DIA.: SSI-SGS (VWS) CONTRACTOR: WEATHER: DRLG MED:			DATE: ELEVATION: DATUM: GEOLOGIST:		3/22/96 D. Teets					
Depth (ft.)	Pro- file	uscs			Geologic D	escription	a	Split Spoon Interval		Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
1 2 3 4 5 6 6 7 7 10 11 12 13 14 15 16 17 18 19 20	1630		5-7 (7-9)	cley, i)ह्य	5, me	moist, somb		7 7 5	551-W5-9.5-	10.5		@7'= 2.4/2.1 @9'=137/2.0 @10'PID=452/1.7 @11'PID=375/1.2
BH -	Borehol	As Above	:		bgs - Belo na - Not A ppmv - Pa HS - Sam SS - Split	Analyzed arts per M ple Heads	Iillion, Volume p space	er Volume			G - Gra	b Sampl	e

PARSONS ENGINEERING SCIENCE, INC.

BS - Brass Sleeve Sample

ft - Feet

						1 1
l	JOB NUMBER.:	726876.68130	CLIENT:	AFCEE/Eaker AFB	DATE:	3/27/96
ı	JOB NOMBER			2 . 1	ELEVATION:	
,	SITE:	Spill Site No. 1	BORING DIA.:	Z-inch		
		- 04	CONTRACTOR:	Parsons ES	DATUM:	
	BORING NUMBER:	SSI-MPA	CONTRACTOR.	Paysons E)	GROT OCICE.	D. Teets
	DIG TIME		WEATHER:	Cldy, smaga	GEOLOGIST:	D. Teets
	RIG TYPE:	(seaprobl				
ı	TEMPERATURE (°F): ~50°F	DRLG MED:	Direct Push		
	I DIVIT DIOLI OLO (T	<i>'</i>				

				Split	Laboratory			
Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
(4)								
1								
						D		
2				1				
3				1		,		
4]			ĺ	
1								
5								
				{				
6				1				
				{				
7				1				
8			8-8		No			
- °	1	i	Silt slelgyer, gray, strong petroleum	\times	No Samples			PiD09'=345/1,0
9	1		odar, st maist		Jampes			P1/204 = 343/10
]			{		1		
10			+255		1			
	-		TD=9	1		İ		
11	1			1				
12	1			1				
	1			-				
13]			-{		1		
	1			-				
14	-			1				
15	┨	İ]				
13	1							
16	1			-			1	
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10	-	1		1				
18	-]				
19	1							
	1			4				
20	1				<u> </u>			

PID - Photoionization Detector

bgs - Below Ground Surface

G - Grab Sample

BH - Borehole

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

SAA - Same As Above Bkgrnd - Background

HS - Sample Headspace

HSA - Hollow Stem Auger

SS - Split Spoon Sample BS - Brass Sleeve Sample

ft - Feet

COMMENTS:

PARSONS ENGINEERING SCIENCE, INC.

DATE: AFCEE/Eaker AFB 726876.68130 CLIENT: JOB NUMBER.: ELEVATION: BORING DIA .: Spill Site No. 1 SITE: DATUM: CONTRACTOR: Parsons Es 551-582 (mpB-5 BORING NUMBER: D. Teets GEOLOGIST: MPB-8 WEATHER: RIG TYPE: Direct Push in40°F DRLG MED: TEMPERATURE (°F):

Г					Split	Laboratory			
	Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
	(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
ן נ	1								
	2		·					ŀ	
1	3								
F	٠]		,		
1	4								
•									P 6,5 + HVA = 240ppm
	5			4.5-6.5: Clay, 5m silt, stiff, dense, hrn/gray, sl petroleun odw, moist					11111 0119
				SI petrolem odw, moist	X	•			
	6								
.	7			165-80': Silt, clayarlose briggy,			l		
				6,5-8,0': Silt, clayar, loss, braggery, SI pet. oder, moist, some sand, f	X				es' THVA=200 ppmV
ן י	8		•		1	1	1		OB THIN-SCOMM
				me // CAA	17	i			
	9			8,5-60' · SAA	1 X			İ	
•	10	1			$V \setminus$				e10' THVA - 3(00ppm
	10	1						-	
	11	1		10.5-11'1 SAA 11-12': SAA except wet	Λ				011 +41A-40000m
				11-12': SAA except wet	X				PID = 47/1.8
	12	4			T	1	1		
	13	-					1		
	13	1							
	14	1			-		İ		
]			-				
	15	1			1		1	ì	
	16	4	İ		1				
	16	-]				
	17	1			1				
1]			-				
	18				1				
		-			1				
	19	-	}]				
	20	1							

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

COMMENTS:

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

DATE: AFCEE/Eaker AFB CLIENT: JOB NUMBER.: 726876.68130 **ELEVATION:** BORING DIA .: Spill Site No. 1 SITE: DATUM: CONTRACTOR: BORING NUMBER: D. Teets GEOLOGIST: WEATHER: RIG TYPE: DRLG MED: TEMPERATURE (°F):

				Split	Laboratory			
		******		Spoon	Sample	Sample	PID	Remarks
Depth	Pro-	USCS	Geologic Description	Interval	Identification	Type	ppmv	
(ft.)	file		Geologic Description					
1								
							İ	
2								
							1	
3						,		
						'	1	
4	1					1	1	
]				1		
5	i					l	1	25 = 5140 = 7 20000 -
	1		55-6.5: Clay, smsilt, dense stiff, ben,	\ /				RS.5 THVA=7,200pm
6	1		1 L of All Steiling. Stoder.	\/		1	1	
	1		Gross Contempeda starte 6,5 bgs				ļ	-75 + 44 (d. 1 000
7	1	1	G.5-75'; Silt, claser and moist strong	! / \		1		07,5'THVA21,000
	1		petroleum adar	/	1			
8	1		7.5-9': SAA	\ /		i		201 -1110-61/20
	1			X				08' THVA=6,400
9	1	ì		K		1	1	67 THUH = 3, 400
	1		9,5-11.5: SAA except increasing clay content					
10	1		with depth. Grandweter of ~ 11'	$\Lambda \Lambda$		1	1	
	1			1 X				211 THVA = >10,000 pm
11	1			\swarrow	J			PH 1HVV - 210,0004
	1				1	1	1	
12	1			4				
	1			4		1	1	
13	1	1		-		ĺ		
	1			-				
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	1			4	İ			
16	1			4	1		1	
	1	1		4				
17	7			4	İ	1		
	7			4	1			
18	1	1		4			1	
	7			4				
19	1			4				
	1			4				
20	┪							

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

			VAV A VI		
ron vith (DED .	726876.68130	CLIENT:	AFCEE/Eaker AFB	DATE:	3/20/96
JOB NUMBER.:				ELEVATION:	
SITE:	Spill Site No. 1	BORING DIA.:	Z-irek		
BORING NUMBER:	551-504/mPD-51	CONTRACTOR:	Parsons ES	DATUM:	
	1.00 0	WEATHER:		GEOLOGIST:	D. Teets
RIG TYPE:	CKG/1010C		2, 101		
TEMPERATURE (°F):	~ yor	DRLG MED:	Direct Myh		

					Split	Laboratory			
5	Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
	(ft.)	file	0200	Geologic Description	Interval	Identification	Туре	ppmv	
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	2								
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▊├									
I	5				ļ		Ì		
			ļ		}		}		
	6				7	·			
		1		6-7.5 : Clsy, sm sitt, grs //brn, wet,	1		}		
	7			Strong pet, odar, Fatty Clay	iΧ				
	8			7.5-8 Silt Filey, gray, moist, stronget.					
1	-	İ	-	740-			1		
	9	1		9-9.5: Fat clay, silty, gray, 11, mo, +, strong]			211/2/14-3 2000014
				, oder					010 THNA=3,500ppm
	10			9.5-10:5: It, smclox, v dense, moist, gray,		1	1		C10,5' THVA-4, 200
				Strong petrodor					011,5 TAVA = 1,10,000
	11	-		10-11.5: Silf, smclay, dense, wet gray, strong					
-	12	-		pet. odu	1				
	12	1							
	13	1			1				
ı		1			4		1		
	14]			-		1		
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	15	-			1		1		
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		1		·	4				
	18]	1		-				
]			-				
	19	4			1	-			
		4			1				
-	20								

PID - Photoionization Detector

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

SAA - Same As Above Bkgrnd - Background HSA - Hollow Stem Auger

HS - Sample Headspace SS - Split Spoon Sample

ft - Feet

BH - Borehole

COMMENTS:

BS - Brass Sleeve Sample PARSONS ENGINEERING SCIENCE, INC.

					. 1 /
JOB NUMBER.:	726876.68130	CLIENT:	AFCEE/Eaker AFB	DATE:	414196
SITE:	Spill Site No. 1	BORING DIA.:	Z-ihch	ELEVATION:	
		CONTRACTOR:		DATUM:	
BORING NUMBER:	SSI-MPE	•	Parsons ET	CEOLOGIST:	D. Teets
RIG TYPE:	Geoprobe	WEATHER:	Clear / sl cloy, Sl bree-	Tru-	D. IEEB
TEMPERATURE (°F		DRLG MED:	Direct Rol	North	

				Split	Laboratory			
Depth	Pro-	uscs		Spoon	Sample	Sample		Remarks
(ft.)	file		Geologic Description	Interval	Identification	Type	ppmv	
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\								
1			See boring logs for MPA or MPB					
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4		:						
]						ļ	
5]							
6								
7								
				1				
8	-			1		1		
9	1							
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10	1			j	No Samples	İ		
	1		MP steen set 0 9.5 bys Sand set p 9-11/bys TD=11/bys		140 July			
11	1		Sand set e 9-11'bis					
	1		TD=11'bss					
12	1	l	J					
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13]			1		1		
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14	1							
	-	1		1			1	
15	4			1		l		
1	4							
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1/	1			1		1		
18	1	1]		1		
1 10	1							
19	1							
	1			1		1		
20				L	L	L	L	

PID - Photoionization Detector

BH - Borehole

ft - Feet

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

				GEOLO	AFCEE/Eaker AFE		<u> </u>			-1 100
JOB NU	MBER.		726876.68130	CLIENT:	3		DATE:		3/22/96	
SITE:			Spill Site No. 1	BORING DIA.:	2"			ELEVAT		
BORIN	G NUMI	BER:	42U5-551-586	CONTRACTOR:	Parsons ET			DATUM		
RIG TY				WEATHER:	GEOLOG	HST:	D. Teets			
TEMPE		E (°F):	~(0<°F	DRLG MED:	Clear, SI bre Direct Push					
COMM		2(1).	43	o' north of t	VW52 VWC	1		•		
COMIN	LITIS.		Lorgies	7 7 601 2 64	035			•		
			T			Split	Laboratory			
		71000				Spoon	Sample	Sample	PID	Remarks
Depth	Pro-	USCS		Geologic Description		Interval	Identification	Туре	ppmv	
(ft.)	file		<u> </u>	Jeologic Description		22.001.12		7,		
1							No Samples			
							,			
2								i '		
3								١.	,	
] `		
4								l		
						6000		i		
5								ł		
			5-7': Fat (la)	1, smsilt den	se sl mout,	\setminus				
6			gravin	enoxide staini	n. No odor or	Х				~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
			Shairia	1	7					ADe7'=14.5/1.0
7				7						
	-		7-91 SAA exc	ept blacks	tringers					
8					<u> </u>			ł		
						X				2/26/
9										PID e 9/=36.0/1.2
								1		
10								Ì		
	·									
11										
			11-17 SAA			\ /			=	C11/PID=41.5/1.4
12				silt/argy	iran oxide	$\mid \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \; \;$				GW & approx.
<u> </u>			Stamm	wet not a	dow. no stainit	/				12 bas
13			38121	WVI) PLI 1	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					013'PD=241/1.4
•										TD=13'bas
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14	ł									
15	1	-								
13	1								l	
16	-		Connects: 5	HOGE TALL A	anolo, m	1		1		
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20	<u> </u>	L			·	1		<u></u>		
				bgs - Below Ground	Surface			G - Grab	Sample	e
		ization D			Surface					
	Borehole			na - Not Analyzed	llion Volume ner V	lume				
1		s Above			llion, Volume per Vo	, and				
	d - Back			HS - Sample Headsp						
HSA	- Hollow	Stem Au	ger	SS - Split Spoon Sam	nple					ļ

PARSONS ENGINEERING SCIENCE, INC.

BS - Brass Sleeve Sample

ft - Feet

MW201

ocu	nou c	¥ 808	RING:		3 ldg				ل			Blyth. AFB	5ite		Boring No TOTAL DEP
					Roa	20	ay					JOB NO.: 459			D ST. A.J
											\neg	PROJ. MGR: J. N		-	D 87: -
		71			-	1				Bld.		ORILLING CONTRA			
,	יח כ			צול	700	ا ہر	Sa ic	ل		1020		DRILL RIG TYPE:			<i></i>
<,	ے د'			دعد		*	50 K	1	1			DRILLERS NAME:			Pagl
								لسم	_			SAMPLING METHO			
							∌	MU	uzo) [HAMMER WT.:	7.77.2		(20)
										•		STARTED, TIME:	1030		42/28
												COMPLETED, TIME			1/23
										7 N		BORING DEPTH (11		1	
										-	Т	CASING DEPTH (ft.)			
						3						WATER DEPTH (IL)			
1				ED	NO.	/up					'	TIME:			
Ξ	PE		EN	VE	Į.	11.				נו	0	DATE:			
DEPTH	SAMPLER TYPE	BLOWS / 8-M.	HCHES BRIVEN	HCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (man/II)	Analytical Sample		. 5. 5	DEPTH IN FEET	007		E:	DATE:	87
SAMPLE	LEF	181	S	2	델	Ě	alp		5.6	Ξ	GRAPHIC	SURFACE ELEV.:		DATU	M: surta
N N	AMP	101	¥3,	3	=	E	42		5	EP	AFI	CONDITIONS: c/e			
8	S	-	<u></u>	=	-	-		-			+	0-3'	1		7
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	-	1	1 4	 	-	-	-	-	1	3	H	2.0/			
			T	4-4	3000	-		ļ	CL		H	3-8	tute		1401
		1	12	1	15	+-	+	 	-	4	H_{-}	Loam, SII	71/ To 12		ar are
7.5		Ì							11		H	some 1	310-63	7 1 - D	um. t
<u>5.5</u>	1	-		+	-	┼-		-	1	5	Н	matte	mo!	E , l	UM. F.
	1							1	ML		H	rootlet.	2 2	7 h	na
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1		-	5	7.	190	-	-	1	1	9	H	dk. brow	4 اکسرون	Wat	ad,
			1 .		2	1	1 /	In C	M	1	11	1 00.0000	e ~41	/ /	AL human
8			11			1	1/	17	WA VA	1	H	lamuiae			dk brou

## 100 ## 20	-	N	200	ATO	7				FIELD	LOG	OF BO	RING	CONTINUEDI SHEET 2 OF 2 PROJECT: BAFB NO. BORING NO. 20
13-18' Silt some v.f. sand abund Silt, dk brown sat, Microsof + 15 16 18 18-23' Sand v fine v sith dk brown Microsov saft 19 10 20 20 20 20 20 21 20 20 21 20 20	Ξ	E	¥.	EN	۷'0	D.	ITE				H	E S	PROJECT: BAFB INO. 180RING NO. 20
13-18' Silt some v.f. sand abund Silt, dk brown sat, Microsof + 15 16 18 18-23' Sand v fine v sith dk brown Microsov saft 19 10 20 20 20 20 20 21 20 20 21 20 20	DEP.	IYP	BLO	De y	PEC.	COH	0.6				05.0	GRA	5:te JP-1
13-18' 13-18'				F						SM	ر مست		
12 13-18' Silt, same v.f. send, abund Silt, dk brown sat, Miceense, saft 16 17 18 19 19 10 10 10 10 10 10 10 10								7	4.9	SM	"	П	
13-18' Sist, some v.f. send, abund sit, dk. brems, sat, miraeaux; soft 16				1					0/11			7	
Sitt same v.f. sand, abund sit, dk. beam, sat, miragenic, soft 18 18 18-23' Cand, v.fine, v.sitt, dk. beam Miracous, soft Botton 0.2' is Sitt grey, w num.thin v.dk. scey laminas -0.1", mad hard 12 12 13 14 15 16 17 18 19 19 19 10 10 10 10 10 10 10					-				1		12	H	
Sitt same v.f. sand, abund sit, dk. beam, sat, miragenic, soft 18 18 18-23' Cand, v.fine, v.sitt, dk. beam Miracous, soft Botton 0.2' is Sitt grey, w num.thin v.dk. scey laminas -0.1", mad hard 12 12 13 14 15 16 17 18 19 19 19 10 10 10 10 10 10 10										!		Н	12 141
15 16 17 18 18 20 20 20 20 20 20 20 20 21 21 21 21 22 21 22 21 22 21 22 25 25 25 26 25 26 26 27 28 29 29 20 20 20 20 20 20 20 20 20 20 20 20 20				1					-)3	Н	13-10
15 16 17 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20	ı				21	200.5				,		Н	Silt, some V.T. sand, abund.
15 16 17 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20				1	-			-	-	 	14	Н	sitt, dk. brown, sat.
18 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20												H	Micaeous, soft
18 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20								_	-	:	15	Н	
18 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20	1											Ц	
18 18 18 20 20 20 20 20 20 20 20 20 20 20 20 20	\downarrow										16	Ц	·
18 18 18 18 Sand, v.fine, v. ilt. dk. bvm. Sand, v.fine, v. ilt. dk. bvm. Micaeous, soft												Ц	
18 18 18 18 Sand, v.fine, v. ilt. dk. bvm. Sand, v.fine, v. ilt. dk. bvm. Micaeous, soft										!	17	Ц	
Botton 0.2' is Sitt, grey, w) num. thin Vdk. gray lamines 20.1", mod hard 12 12 13 15 15 16 17 8 9 9		. }								1	1		
Botton 0.2' is Sitt, grey, w) num. thin Vdk. gray lamines 20.1", mod hard 12 12 13 15 15 16 17 8 9 9				1									18-23'
Botton 0.2' is Sitt, grey, w) num. thin Vdk. gray lamines 20.1", mod hard 12 12 12 13 13 TD = 23 D-Sample to lab 8 9				1		J				1	10	П	Sand whise weith dr. burn
Botton 0.2' is Sitt, grey, w) num. thin Vdk. gray lamines 20.1", mod hard 12 12 12 13 13 TD = 23 D-Sample to lab 8 9	- (5	4'	900						П	Missague coft
22 23 7D = 23				1					1	1	19	Ħ	THE RESULT AND A
22 23 7D = 23 24 25												Н	Batta B 2' : 5'H
22 23 7D = 23 24 25					_				1		20	Н	and the die
22 23 7D = 23 24 25				1 (1			H	Tall and hand
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$					-	<u> </u>					21	H	-0.1 , Mad hard
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	į			{								Н	
25						-	-	-	-		12	Н	
25										4	1	Н	
25				1	-			-	1	217	23	 	
25					}			1	0.7	jsm		Η·	TD = 23.
6 - Sample to lah.				-	-	-	_	17	الالا	1-	24	H	
6 - Sample to lah.				1		1						Н	
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8 9						1			1		1	Ц	1 - Sample to lab
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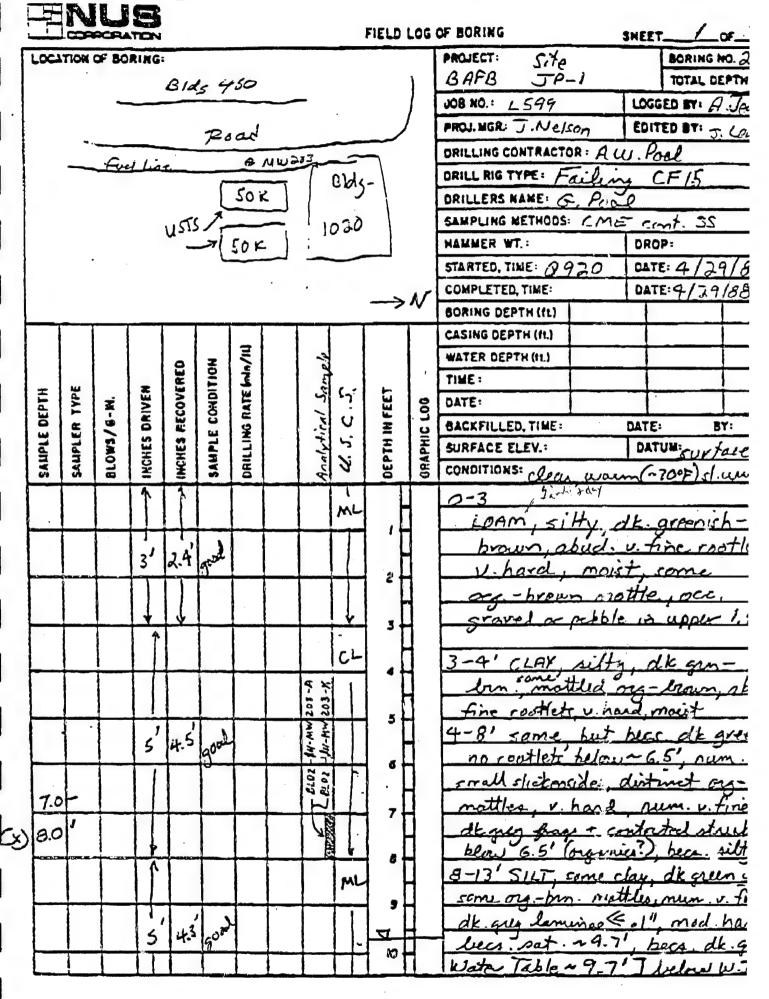
FIELD WELL COMPLETION FORM	•	CHRISTY BOX
HAME: BAFB IP-1 site		CLOCKING STEEL COVER
JOU PROJECT LETT MANAGER: J	Nelson	STEEL CONDUCTOR CASING
LOGGEO 2. Yelkis BY:	LPWis	tofeet
WELL MW-201	104 JE 128	NOREHOLE SOREHOLE
COMPANY: A. W. Pool	······································	BOREHOLE
EQUIPMENT: 274 INCH HOLLOW STEM AUGER	G. Pool	BENTONITE-CEMENT
I INCH ROTARY WASH	HOURS ORILLED:	SEAL OR J B-SACK CEMENT-SAND
CALLONS OF WATER USED DURING ORILLING:	GALLONS	TO
METHOD OF DECONTAMINATION		2.96
DEVELOPMENT	an	TOP OF CASING AT
METHODOF		GENEVIGROUND LEVEL
DEVELOPMENT: Directory		74 INCH DIAMETER
BEGAN DATE: YIME:	DATE	0 to 23. 1 ear
GPM FROM TO	DATE	SCHEDULE 40 PVC
GPM FROM TO	DATE	BLANK CASING + 3.0 to 7.0 feet
GPM FROM TO	DATE	E BENTONITE-CEMENT
GPM FROM TO		SEAL OR SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS	SEAL
AT ERM OF	IGHTLY CLOUDY	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID UVE	ERY MUDDY	SEAL
CDOR OF WATER:		6- 4:06 1000 1000 Silvia 12-28
MATER DISCHARGED GROUND SURFACE GTANK		SAND PACK
DSTORM SEWERS DSTORM	GETANK .	= 6.023 teet
OFFTH TO WATER	FEET	SLOTTED : 0.010
MATERIALS USED	-	7.0 - 22 (set
	. •	2
3 SACKS OF 12-28	SAND	SCHEDUCE 40 PVC BLANK SILT TRAP
SACKS OF PORT . TYPE TE	CEMENT	Btoteet
GALLONS OF GROUT USED	25.1	BOTTOM WELL CAP
SACKS OF POWDERED BENTONITE	- 3.6	2 <u>2.1</u> ten
POUNDS OF BENTONITE PELLETS 10 6 FEET OF 2 INCH PVC BLANK CASING	22.1	HOLE CLEANED OUT TO
15 FEET OF 2 INCH PVC SLOTTED SCREE	•	BOTTOM OF BOREHOLE
1-0.1' screw on bott-cap		23. Inet
YARD CEMENT-SAND (REDIMIX) ORDER	RED	NOT TO SCALE
YARD CEMENT-SAND (REDI-MIX) USED		ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? DNO DYES		riser + screen steam
NAME	-	cleaned
WELL COVER USED: TOCKING STEEL COVER		* prior to cut-off
CHRISTY BOX		THIN 10 CH OIL

01/18/96 14:17 2501 532 8738 **国NUS** MWZOZ FIELD LOG OF BORING SHEET___ BAFB JP-1 LOCATION OF BORING: PROJECT: BORING NO. TOTAL DEPTI ROAD LOGGED BY: A.Q JOB NO.: 1598 EDITED BY: J.L. PROJ. MGR.: T. Nelson fuel line DRILLING CONTRACTOR: A. W. Pool Blds DRILL RIG TYPE: Failing 50K DRILLERS NAME: G. Pos ; SAMPLING METHODS: CME cont. 55 HAMMER WT.: DROP: STARTED, TIME: :1350 DATE: 4/28 COMPLETED. TIME: DATE: 4/28 BORING DEPTH (ft) CASING DEPTH (H.) DRILLING RATE (MA/II) WATER DEPTH (tt.) SAMPLE CONDITION NCHES RECOVERED TIME : SAUPLER TYPE PECHES DRIVEN SAUPLE DEPTH DEPTH IN FEET DATE: BLOWS/6-M. BACKFILLED, TIME: DATE: DATUM: 50-fa SURFACE ELEV.: CONDITIONS: 0-3' CLAY, some sit dk greenish some org-brown nottle, min hard, abud fr. time root 2.7 3-81 CLAY some silt arcenish liekter than above) much aro - b mottle most hard abund v. rootlets v. smill slickensides rare small encular concretion v. hard * (<.5") @ 6 becs. SIL some clay, dk eyeen w/ some or. 7.5 8-13' Water Table @ 9' SILT, dk. green, mad hard soft, sat a va' a

	~		15				—	1000	200			CONTINUED) SHEET 2 OF 3 PROJECT: BAFB NO. L544 BORING NO. 5
ОЕРТН	IYPE	BLOWS	DRIVEN	REC'V'D	COND	D.RATE				ОЕРТИ	GRAFHIC	JP-1 site
ā	-	8	Ö	<u>~</u>	8	۵			-	0	5	Same Same
-								-	-	11	-	@~11.5 feet becs. SILT, w//v.f. sond, med - dk brown mod hard to soft, sat.
											1	Sona med - ak Drown mod
十		-	-					-		12	-	Mard to soft, sat-
			1						1		1	
1		•	1					10	CM	13	1	i3-18'
							(1/3/4	SM	1	+	
								11	1	14	1	SAND, v. fine w/ shoul silt, sil de brown sat, soft to
											-	ak proun sot, soft to
十				1					-	15	-	med. nard micaeous
- 1			5'	2.5	good						1	
+					9				-	16	-	
									1		1	
+										17	-	
			*								-	14 001
+			1					10	Cha	18	-	18-23'
								110	学	1		SAND, v. fine, w/ about ill
+	{							<u></u>		19	-	silty, dk. brown, sat.
			Ly.	فأسر	الحوود						-	soft to mad hard, micatou
-			-1-1	4.	900.1					20	4	
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											•	T0=23'
+										24		
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FIELD WELL COMPLETIO	N FORM				CHRISTY BOX
HAME BAFB JA	-1 site		П		TLOCKING STEEL COVER
HAME DAPE JP		Melson	. 4}-		STEEL CONDUCTOR CASING
LOGGEO a. Cheukins	EDITED 7	- / /	11		tofeer
WELL MW-20		PATE:/28			THE INCH DIAMETER
COMPANY: A.W. FOO!					toteet
EQUIPMENT: / TV.	OLLOW STEM AUGER	S. Pool			BENTONITE-CEMENT
_	OTARY WASH	HOURS ORILLED:			8-SACK CEMENT-SAND
GALLONS OF WATER USED DURING DRILLING:	12	GALLONS			tofert
METHOD OF DECORTAMINATION PRIOR TO DRILLING:	sterm cles	•		2	.5) 4 # TOP OF CASING AT
DEVELOPMENT .		aring			#3.5 FEET ABOVE #
METHOD OF BAILING					- INCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:			-	BOREHOLE 0 :0 23 feet
YIELDI TIME:	70	DATE			2 INCH DIAMETER
YIELD: TIME:	то	DATE			SCHEDULE 40 PVC BLANK CASING
YIELD: TIME:	то	DAYE			+3.5 to 6.6 leet
TIELD: TIWE:	TO	DATE:	· .	-	SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENTS	10	GALLONS	'	•	SEAL 3.7
DESCRIPTION OF TUNBIDITY	, n	LIGHTLY CLOUDY	3.7'-	88 882	0 825
AT END OF DEVELOPMENT: MOD.		ERY MUDDY			SEAL
CDOR GF			· ن ن		3.7:0 6_ reet
MATER DISCHARGED DISCHARGED	URFACE TANK	TRUCK			SAND PACK
STORM SE		AGE TANK			
DEPTH TO WATER AFTER DEVELOPMENT:	□ OTHE	FEET			INCH DIAMETER
MATERIALS USED		PEE!			6.6 :021.6 feet
7	5.2		•		NEW BLANETED
3 SACKS OF 12-		SAND			SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF PAR		CEMENT			100 100 101 101
GALLONS OF GROW			5.1	<u></u>	BOTTOM WELL CAP
25 POUNDS OF BENTO	NITE DELLETS		3.5		HOLE CLEANED OUT TO
10 FEET OF 2 INC	H PVC BLANK CASIN	ي ان	.6		21.7 feet
15 FEET OF 2 INC	H FVC SLOTTED SCR		L		BOTTOM OF BOREHOLE
1-0.1' serewon	bott. cap				23_tem
YARD CEMENTSA			N	OT TO SCAL	E _
YARDI CEMENT-SA					INFORMATION:
CONCRETE PUMPER USED?	THO TYES			rispe t	screen steam
WELL COVER USED: WZLOCKI	ne errer en en	_	٠ ــ	cheaned	
☐ CHRIST	LA BOX		*	poir.	to cut-off
MANUER			A.1		



<u>.</u>	000	POR	ATO	٧			FIE		OF 80	RING	CONTINUEDI	SHEET & OF
Ξ	111	55	2	4.0	o o	12		3565	Ξ	PHIC	PROJECT: BAFB	NO. L544 BORING NO. 2
DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COHD.	D.RATE		135	ОЕРТН	GRA	site JP-1	SHEET 2 OF 2 NO. L544 BORING NO. 2 4/29/6
			F	Ī				11.	1 1	-	some IN. S	L X-hedding, B' k, V. fine sond
									1 ''	7	to share hind	Lx-heddi
						.				7	4.5.4.4.4.4.4.4.2	41 1
			1	1				 i 	12	\dashv	meters gar	J. V. Tine Sond
			V					ML		7	Builton ME.	
	-		1	1	-				/3	Н	12-10/ 017	
										H	13 10 SILI	some v. fine sand, V. uniform, soft brown t, sot.
-		-			-				14	H	dk sieco	V. Unitorm, sott
İ										\dashv	becs more	brown + sot
_			1						15	4		
			51	21	3000			:		Н		
_ !			ס'	3	3			1	15	Ц		•
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			¥	1				V	18			
			4	1				1	,,,		18-23' SAN	D. V. fine . wl
										П	some silt	D, v.fine, w/ dk brown, becs. yellow-bm
									19	П	coff sut	becs wellowshow
						-		11		П	is uniform	yours on
			,	1	Sout				20	П	-0.14(0)767	
			5"	41	good			_				
				T	1		/a	M	21	П		
					1		(17/1	WE'M				
			-	1				1	22	Н		
			1	11				-11	1	Н		
			1	A	-		-		23	Н	22 221 200	^
			1	1	1			11		H^{\perp}	AD-TO SAND	v. fine, w/come.
				┼	-				24	H	sit, dkg	veen abund dar uniform, v soft
			Ι.	1						Н	gruns, v	uniform, u.soft
				50.	-				25	Н	soft, sat	91
			5'	3.0	Took	1 1		11		H	botton 0.2	is SILT, dk to
			-	-	15				26	Н		en v.fino dk lam
					1					H	hard	
	 		-	₩	-				2.7	H		
			11			1				Ц		
			4	1				Y	78	Ц		
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					1			Ĭ	1		4. 1.6	The state of the s



FIELD WELL COMPLETION	FORM	CHRISTY BOX
MANE: BAFB Site J	-P-i -	LOCKING STEEL COVER
108 HUMBER: L599	PROJECT J. Nella	STEEL CONDUCTOR CASING
LOGGED A. Jentins	EDITED J. Lewis	
WELLE: MW 203	PATE /29/89	774 INCH DIAMETER
DNILLING A.W. Pool	412100	BOREHOLE to to to
	LOW STEM AUGER G. POOL	BENTONITE CEMENT
Inch hold	HOURS	SEAL OR SACK CEMENTSAND
CALLONS OF WATER		II I II SEAL
METHOD OF DECONTAMINATION	GALLONS	Z.67 **
PRIOR TO DRILLING: PYECS	ure steam	TOP OF CASING AT
DEVELOPMENT		DELOW GROUND LEVE
DEVELOPMENT: Bailing		THINCH DIAMETER
DEVELOPMENT BEGAN DATE:	YIME:	0 to 28 teet
	TO DATE:	SCHEDULE 40 PVC
	TO DATE:	BLANK CASING
GPM FROM	TO DATE:	+40 to 6.0 Test
GPM FROM	TO	A BENTONITE-CEMENT SEAL OR B-SACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS	SEAL O. 3-5
DESCRIPTION OF TURBIDITY AT END OF	SLIGHTLY CLOUDY	BENTON) TE PELLET
DEVELOPMENT: MOD. TUP	REID VERY MUDDY	SEAL 2.5.5
CDOR OF WATER		12-28 silver
WATER DISCHARGED GROUND SUR		SAND PACK
STORM SEWE	RS DSTORAGE TANK	5 to 27 feet
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED : 0.010
MATERIALS USED		mont SCREEN 6:0 Pliest
		INCH DIAMETER
5 SACKS OF 12		SCHEDULE 40 PVC BLANK SILT TRAP
sacks of Port		loc_t
GALLONS OF GROUT		BOTTOM WELL CAP
SACKS OF POWDERED		21.1 teet
25 POUNDS OF BENTONIT	2726610	HOLE CLEANED OUT T
15 FEET OF 2 INCH P		LOTTOM OF BOREHOL
1-0-1' spew on b	vestotted screen 21.1	28 leet
YARD CEMENT-SAND	•	NOT TO SCALE
YARD CEMENT-SAND		ADDITIONAL INFORMATION:
CONCRETE PUMPER USED?		* prior to cut-off
NAME		** After 1-33' cut off and
WELL COVER USED: TOLOCKING	STEEL COVER	survey completed.



WELL NO. MW205

SHEET _ 1 _ OF _ 2

745		CUR	<u>run</u>	AHU	IN								
PROJ	ECT:			EAK	ER A	AFB F	RFI		JOB	NO.:		01	14 BORING/WELL NO.: MW205
									LOGG	GED	BY	/ :	BDH TOTAL DEPTH OF BOREHOLE: 21.5
DRIL	LING	CONT	RACT	OR:		Tri-S	tate	Testir	ng				SURFACE ELEV.: DATUM:
DRIL	LER'S	NAM	E:	Doe	2	log	ger						START TIME: 1441 DATE: 4/9/95
DRIL	L RIG	TYPE	. (<u></u>	ME	-05	5						FINISH TIME: 1600 DATE: 4/9/95
BORI	NG M	ETHO	D: /	15/									WATER DEPTH:
HOL	DIAN	METER	t:	74	"								DATE:
SAM	PLING	MET	HOD:	Lo	tin	you	<u> </u>						TIME:
НАМ	MER \	WGT.		NA			DRO	HGT	NA				BACKFILLED, TIME: DATE:
SURF	ACE	COND	ITION	S:	Dry	m				_			WEATHER: Jan, upper 70°5F, strong in
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 8-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET		гітногоду	SKETCH OF BORING LOCATION
						1	ı	1			TI		MATERIAL DESCRIPTION
2.7			1.2 5.0	5.0	0 0 1 30	sla sla sla	ist	0) R 3/2 10 YR 4/1	(1 - 2 - 3 · 4 · 5 · 4 · 7		63	Dery Sark growsh bh, stiff; nowheh promot bn, roothers, dry 1.4' - 6.3' (lay silvy, dark gray, mother grange bn, very stiff; much roothers, sh moist; less silt ~1' down onto 6.3' EDI -54- MW 205 A 5.2'- 5.7' 30ppm clay O 1457 6.3'- 11.8' (lay, silvy dark growsh bro very still, because by slive bro
7.7			Marco America			200	**************************************			9			1254) 0 2 6.6 7.4 is 2.5 4 5/2
L								L.,		40			9.7-10.2 E02-54-MW205B-2000m

EDITED BY/DATE: 2 clay @1506



WELL NO. MW205 SHEET _ 2 OF 2

	COL	FUR	Anc	/1 <u>V</u>											
PROJECT	:	EAK	ER AI	FB RF	-1				JOB NO.: 0114 BORING NO.: N						
INTERVAL SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	птн.					
12.7		5.0	-	400	MEN LIGH		2.5' 4/2 2.5) 4/2	Y	11- 12- 13-	11-8	Ah grayish br. n. 11.8-215 Sand, very frogral 10001, Gral 10001, Josh, grayish br.	ofted org. In			
)7.7		5.D	2.2	3	we+	sot			15- 16- 17- 18		12.7'-13.4' clayey s	·			
21.5		3.8	1.8	3					20 - 21 - 22 -						
	in about											The second secon			

EDITED BY/DATE:_ NOTES:



FIELD WELL COMPLETI	ON FORM			CHRISTY BOX
100 6 10 151	n			LOCKING STEEL COVER
NAME: CARA AFE	PROJECT MANAGER:	4T	41-57	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED 13 DH	EDITED BY:			tofeet
WELL MW205	100.	4 19/95		BOREHOLE
DRILLING M.	6 1	19 19 19 3		tofeet
COMPANY: JM Style	2 Lesting	DEUL SEIO		BENTONITE CEMENT
₩ 14 INCH	HOLLOW STEM AUGE	A Me legge		SEAL OR 8-SACK CEMENT-SAND
GALLONS OF WATER	ROTARY WASH	DRILLED:	11 1 1	SEAL ·
USED DURING DRILLING:	NA	GALLONS		10
METHOD OF DECONTAMINATION TO DRILLING:	Storm 1	Bona		TOP OF CASING AT
DEVELOPMENT	•			SELOW GROUND LEVEL
METHOD OF DEVELOPMENT: SERV	seu pereco.	ement form		NCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:			D to 2 1.5 feet
YIELD: TIME: GPM FROM	то	DATE:		2 INCH DIAMETER
YIELD: TIME:	то	DATE:		SCHEDULE 40 PVC BLANK CASING
YIELD: TIME:	то	DATE:		+ 2.6 to 9.1 feet
YIELD: TIME: GPM FROM	то	DATE:		BENTONITE-CEMENT
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS		B-SACK CEMENT-SAND
DESCRIPTION	A.P	LIGHTLY CLOUDY	***	0 10 3.0 feet
AT END OF	_	ZERY MUDDY		BENTONITE PELLET SEAL
ODOROF			***	5.0 .0 7.0 reet
WATER GROUND	SURFACE TANI	K TRUCK		SAND PACK
TO: STORM S		RAGE TANK		7.0 10 21.5 feet
DRUMS	□отн	ER		Z INCH DIAMETER
DEPTH TO WATER AFTER DEVELOPMENT:		FEET		SLOTTED (0.0 /
MATERIALS USED				9.1 to 19.1 feet
10.5 SACKS OF H	20/4050/6	la mone		2 INCH DIAMETER
	207 10390 3	<i>[]</i>		BLANK SILT TRAP
SACKS OF		CEMENT		19.1 to 21.1 feet
GALLONS OF GRO				BOTTOM WELL CAP
75 SACKS OF POWDS			<u> </u>	HOLE CLEANED OUT TO
17	ONITE PELLETS			21.5 feet
	CHPVC SLOTTED SCR	a a saine a saine		FIGH SHORE SOME HOLE
2.0 Bet of 2	is dissipation	Aga		= 245 m
YARO CEMENTS		SEREO	NOTTO	SCALE
	SAND (REDI-MIX) USE			NAL INFORMATION:
CONCRETE PUMPER USED?		-	AUUITIO	MALINFORMATION:
NAME	U140 [[185			· · · · · · · · · · · · · · · · · · ·
WELL COVER USED: LOCK	ING STEEL COVER			
CHRIS	STY BOX			
Corus	D			



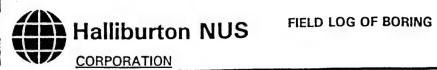
NOTES:

FIELD LOG OF BORING

WELL NO. M 4206
SHEET / OF Z

BORINGWELL NO .: M 4206 JOB NO.: 0114 **EAKER AFB RFI** PROJECT: TOTAL DEPTH OF BOREHOLE: 23.0 BDH LOGGED BY: DATUM: SURFACE ELEV .: Tri-State Testing DRILLING CONTRACTOR: DATE: 4/12/95 START TIME: 1155 DRILLER'S NAME: DATE: 4/12/95 FINISH TIME: 13 03 DRILL RIG TYPE: WATER DEPTH: BORING METHOD: DATE: HOLE DIAMETER: SAMPLING METHOD: Continuous TIME: DROP HGT: NA **BACKFILLED, TIME:** NA HAMMER WGT.: WEATHER: PANLLY SURFACE CONDITIONS: grass AB SAMPLE NUMBER OVA READING (ppm) NCHES RECOVERED SAMPLE INTERVAL BLOWS / 6-INCHES MUNSELL COLOR NCHES DRIVEN SAMPLE TYPE LITHOLOGY MOISTURE SKETCH OF BORING LOCATION MATERIAL DESCRIPTION 0.5 2.3 2.3 aray mouled orange 2.8 most fun 4.3'-4.8' EO2-54-MW206A@ 1155 5.0 5.0 J 5.0 7.8 12 7

EDITED BY/DATE:



WELL NO. MW206 SHEET 2 OF 2

PRO.	PROJECT: EAKER AFB RFI										JOB NO.: 0114 BORING NO.: M 1/2						
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET		гтн.					
12					90 150	noly	fun			12 -			11.3' - 11.8' EO2 -54 - MW2068 @ 1205				
1			50	5.0	150 150 4		nfr			15-	H	15.4 15.9	15.4'-15.9' (lay, siby laminal,				
17.8			5.0	5.0	1 0	aust -		2.57 6/3 2		18-		9.2	19.2'-20.2' filt, clayer, laminated light yellowish born.				
2.8					2	John	M	2.5°		22- 23-			blush grow, method reddish low. 20.9 - 23.0' Sond, very fine grand, vot, soft, light yellowish low.				
		- 1						9 (4) 2 (4) 3 (4) 4 (4) 5 (4) 6 (4)	2000 (100) (1000 (1000 (100) (1000 (1000 (100) (100) (1000 (100) (100) (1000 (100) (100) (1000 (100) (100) (100) (1000 (100) (100) (100) (1000 (100) (100) (1000 (100) (1 (2.5) 1 (2.5) 1 (2.5)							
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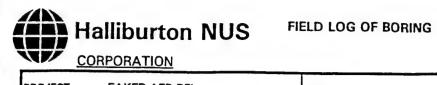
FIELD WELL COMPLETION FORM	CHRISTY BOX
	LOCKING STEEL COVER
NAME: Carles AFB	INCH DIAMETER
NUMBER: 0114 PROJECT MANAGER: AT	CASING
LOGGED BDH EDITED	tofeet
WELL DALLAND	5 INCH DIAMETER
COMPANY: M-State Jasting	BENTONITE CEMENT
19 79 INCH HOLLOW STEM AUGER 160 7 6	SEAL OR SEACK CEMENT SAND
INCH ROTARY WASH	SEAL .
GALLONS OF WATER USED DURING DRILLING: NA GALLONS NA	A tofeet
METHOD OF DECONTAMINATION Boan Chare	TOP OF CASING AT
DEVELOPMENT	2.4 FEET ABOVE AT
METHOD OF .	104 INCH DIAMETER
DEVELOPMENT:	BOREHOLE D:023.0 teet
BEGAN DATE: TIME: DATE:	_ -
GPM FROM TO	INCH DIAMETER SCHEDULE 40 PVC
GPM FROM TO	BLANK CASING + 2. 4 to 11.D feet
YIELD: TIME: DATE:	BENTONITE-CEMENT
YIELD: TIME: DATE:	SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS	SEAL 0 10 5.0 feet
DESCRIPTION OF TURBIDITY CLEAR SLIGHTLY CLOUD	1000 1000 1000 1000 1000 1000 1000 100
AT END OF DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL
ODOR OF	<u>5.0 to 9.0</u> feet
WATER GROUND SURFACE TANK TRUCK	SAND PACK
TO: DISCHARGED STORAGE TANK	9.0 to 23.0 teet
DRUMS OTHER	
DEPTH TO WATER AFTER DEVELOPMENT: FEET	SLOTTED (_D, D !)
MATERIALS USED	11.0 to 23.0 feet
10½ SACKS OF 50/b 20/40 Morie SAN	2 INCH DIAMETER
	BLANK SILT TRAP
SACKS OFCEM	ENT 21.0 to 23.0 feet
GALLONS OF GROUT USED	BOTTOM WELL CAP
SACKS OF POWDERED BENTONITE	2 <u>3.0</u> feet
13.5 POUNDS OF BENTONITE PELLETS	HOLE CLEANED OUT TO
FEET OF INCH PVC BLANK CASING	607704.05.000540.5
10-0 FEET OF 2 INCHPVC SCOTTED SCREEN	23.0 foet
YARD ³ CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE
YARD CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? ON OYES	
NAME	
WELL COVER USED: LOCKING STEEL COVER CHRISTY BOX	
Dotues Dov	



FIELD LOG OF BORING

WELL NO. MW 207
SHEET _ 1 _ OF _ 2

		<u> </u>	11 01	AIN	<u> </u>							
PRO.	PROJECT: EAKER AFB RFI JOB NO .:											BORING/WELL NO.: MW207
_									LOG	GED	BY:	BDH TOTAL DEPTH OF BOREHOLE: 23. 1
DRIL	LING	CONT	RACT	OR:				Testi	ng			SURFACE ELEV.: DATUM:
DRIL	LER'S	NAN	IE:	_	re	11	egg	n				START TIME: 1935 DATE: 4/10/95
DRIL	L RIG	TYPE	:		1E	-54	540					FINISH TIME: 1000 DATE: 4/10/45
BOR	NG M	ETHO	D:		5 A							WATER DEPTH:
HOL	E DIA	METE	R:	1	七"							DATE:
SAM	PLING	MET	HOD:			din	ous	<u>/-</u>				TIME:
нам	MER	WGT.	:	. N	A		DRO	P HGT	r: /	VA		BACKFILLED, TIME: DATE:
SURI	ACE	CONE	OITION	is:	es	you	<u> </u>					WEATHER: Partly Oldy, lo 70°5F, stopy, austus
SAMPLE INTERVAL SAMPLE TYPE BLOWS / 6-INCHES BLOWS / 6-INCHES INCHES DRIVEN INCHES DRIVEN OVA READING (ppm) MOISTURE DENSITY MUNSELL COLOR LAB SAMPLE NUMBER DEPTH IN FEET												
8	4	8	=	=	0	_≥	_	≥		٥		SKETCH OF BORING LOCATION
			l .	ı	T	T	ī	ه دا	l,			MATERIAL DESCRIPTION
	D day 4/2											0-4.4 (lay, sitry, dry, stiff, w/ roorlots; donk grayest los.
3.0										3 -		4.4'- 5.6' Land, ily, clayer, w/
			5.6	4.0	,	mero	r	2.54	/	y - 5-	<u>4.4</u>	roch frogs - rounded - subvoried survey, says to "dian, dry, soft be browning gray 4.5'- 5.0' sample # E02 - 54-MW 207A @ 0900
					,						5.6	5.6- 13.2 Cru, when were the man
$ \psi_{i} $					0	ر. ا		2.5	,	6 1		brown, stimost, very fine sand, clayer
						mer		3/2		7+	-	6.2 - 6.3
∢ .0					3	* TARRES	4.11				1	mottled reddied for
					. 14	ander Allegaria	TITE AT		127 71.0	7-		
			5.0	3.8	60	-	4-	1.5	,	9_		9.5-10 sample, 6000m, clay,
					50	No.	joigh	4/2				sitis, very stiff (2.5.4) duck grayed
NOTE	:s:											EDITED BY/DATE:



WELL NO. MW 207

SHEET 2 OF 2

PRO	PROJECT: EAKER AFB RFI									JOB NO.: BORING NO.: M W267							
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET		итн.					
18			5.0	3.4	30 280 3000 110 500	mest Wet	sof	2.5\- \(\q \)		130 11-12-13-14-15-16-17-18-19-20-21-		J3.2	13.2'- 23.6' Sand, very fine grant to silt, well moted, soft, west, doub grayist bru. Strong fuel order.				
NOTES	::										_		EDITED BY/DATE:				



FIELD WELL COMPLETION FORM	CHRISTY BOX
	D LOCKING STEEL COVER
NAME: Other AFB JOB NUMBER: 0114 MANAGER: A T	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED EDITED	toteet
WELL MAN (A.S.)	INCH DIAMETER
DRILLING .	BOREHOLE .
EQUIPMENT: 15 Th	BENTONITE-CEMENT
INCH HOLLOW STEM AUGER TO THOURS	SEAL OR B.SACK CEMENT SAND
GALLONS OF WATER A/A	
METHOD OF DECONTAMINATION	707.05 010WG 17
PRIOR TO DRILLING: Stopm Capper	TOP OF CASING AT
DEVELOPMENT	SELOW GROUND LEVEL
DEVELOPMENT:	BOREHOLE ,
DEVELOPMENT BEGAN DATE: TIME:	O :023. b teet
GPM FROM TO	2 INCH DIAMETER
TIME: DATE:	BLANK CASING + 2.5 to 11.6 feet
YIELD: TIME: DATE:	
TIME: DATE:	SEAL OR S-SACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS	SEAL D 10 7.0 feet
DESCRIPTION OF TURBIDITY AT END OF	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL 7.0 10 9.0 'eet
ODOR OF WATER:	
MATER DISCHARGED GROUND SURFACE TANK TRUCK	SAND PACK
TO: STORM SEWERS STORAGE TANK DRUMS DOTHER	7.0 10 27.6 feet
DEPTH TO WATER	SLOTTED (0.0)
MATERIALS USED	inch SCREEN
	11.6 to 21.6 feet 2 INCH DIAMETER
9 2 SACKS OF 50/h 20/40 mone SAND	SCHEDULE 40 PVC 5.5.
SACKS OFCEMENT	21.6 to 23.6 feet
GALLONS OF GROUT USED	BOTTOM WELL CAP
SACKS OF POWDERED BENTONITE	23.6 feet
14.1 FEET OF 2 INCH PVC BLANK CASING	HOLE CLEANED OUT TO
10.0 FEET OF 2 INCHPVC SLOTTED SCREEN	BODIOMOF BOREHOLE
2.0 fact of 2 inch 55 will trip	2.5
YARD CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE
YARD ³ CEMENT-SAND (REDI-MIX) USED	
CONCRETE PUMPER USED? NO YES	ADDITIONAL INFORMATION:
NAME	
WELL COVER USED: LOCKING STEEL COVER	
OTHER	

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW 209

SHEET / OF 2

CORPORATION BORING/WELL NO.: ~ ハスとつ JOB NO.: 0114 EAKER AFB RFI PROJECT: TOTAL DEPTH OF BOREHOLE: LOGGED BY: G. Milliam DATUM: SURFACE ELEV .: DRILLING CONTRACTOR: Tri-State Testing DRILLER'S NAME: John Crawford DATE: 6 120 95 START TIME: 1001 DATE: 6/20/95 FINISH TIME: 1550 DRILL RIG TYPE: CME 75 BORING METHOD: 7 1/4" ItsA overdilled W/10" HSA WATER DEPTH: DATE: HOLE DIAMETER: TIME: SAMPLING METHOD: Continuous Samplina NA DROP HGT: BACKFILLED, TIME: HAMMER WGT.: NA WEATHER: Rain, Temp 65°F. SURFACE CONDITIONS: Grassi Crassy ONW209 AB SAMPLE NUMBER OVA READING (ppm) NCHES RECOVERED MWZOS BIDG 4150 SAMPLE INTERVAL SLOWS / 6-INCHES Corrosion MUNSELL COLOR NCHES DRIVEN control SAMPLE TYPE concrele ITHOLOGY. MOISTURE DENSITY SKETCH OF BORING LOCATION MATERIAL DESCRIPTION 0/5/t was 10/18 , 5' - 9.0' - SILT; Some Clay 0 gravel ~ 1/4 inch - 1. nch; more gravel from 1.51-2.01. brn 0 311. ioya 2.0'- 5.0' - Clayer SILT, D dk brn. 5,0'- 8.0' silty clay, dk grayish brn, mottled w/ 10ur 5/6 yellowish brni root-SFT SFT 0 0 CL Min Set 8.0- 10.0' clayey SILT; bm - moHed WI love 5/6 yellowist 0 brn. less clay from= 9 3 10.0'- 13.0' - Silty CLAY; brn. F05-54 moHIAd W/ 104R5/6 yellowish brn: clayer SILT filled root

NOTES: To determine the extent of plume EDITED BY/DATE:



NOTES:

FIELD LOG OF BORING

WELL NO. MW 209

SHEET 2 OF 2

Casts or worm burrows. Casts or worm burrows. Casts or worm burrows.	Color Change to 100 100 100 100 100 100 100 100 100 10	PROJECT: EAKER AFB RFI										JOB	NO.		0114	BORING NO .: MW209
13.0'-14.5 CLAY; brn. some 10.00 Soft 10.00	13.0'-14.5 CLAY; brn. some 10.751/2 yellowish brn. mothling. 13 CL 145'-15- sitty CLAY; brn. 15 15 15 17 9 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.			
		- 2 2	्रिश्च हैं - - - - - - - - - - - - - - - - - - -		5-1	3FT	0/0 0/0 0/0 0/0 0/0 0/0	TE SAT NO SAT	新 · · · · · · · · · · · · · · · · · · ·	104K 412 104K 4/2		12 13 14 15 16 17 18 19 20 21 22 23 24	M CI S/	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	13.0'-14.5 CLAY 1048516 yellow: Mottling: 14.5'-15- silty less 1048516 ms above (vellowis 15.0'-15.5' CLA plastic; dk grayis less mottling th 15.5'-16.5'- S sand; dk grayis is fg; well sort 16.5'-17.0'- CLAN brn., few mottl dk yellowish br 17.0'-17.5'- Sand SAND; Vfg; We dk yellowish b 17.5'-20.0'- as color Change t dk grayish br 20.0'-25.0'-56 Well sorted; ar dk yellowish br	CLAY; brn; thing than thing than thing the silt; an above; ILT; some the brn; sand ed 917; angular t; dk. grayish es 104 k 4/6 11. Sorted sand. which sand. above w/ above w/ above w/ above w/ above w/ above w/ above w/ above w/ above w/ above w/

EDITED BY/DATE:_



TOP OF CASING AT TIME. CALLONS OF MATCH TIME. CALLONS OF MATCH TIME. CALLONS OF MATCH TIME. CALLONS OF MATCH TO DATE: COUNTERN'T TIME. CALLONS OF MATCH TO DATE: COUNTERN'T TIME. CALLONS OF MATCH TO DATE: COUNTERN'T TIME. CALLONS OF MATCH TO DATE: COUNTERN'T TIME. COUNTERN'T TIME. CALLONS OF MATCH TO DATE: COUNTERN'T TIME. COUNTERN'T TIME	FIELD WELL COMPLETION FORM	CHRISTY BOX
MANNEER CALLY FEB STEEL CONDUCTOR STEEL CONDUCTOR CASING Inch DIAMETER STEEL CONDUCTOR CASING Inch DIAMETER STEEL CONDUCTOR CASING Inch DIAMETER BORENCE Inch DIAMET	108	LOCKING STEEL COVER
ALLORED GOLD FOR THE STAND SUPPLED GALLONS OF PRODUCT OF SEAL	NAME: Eaker AFB	
METHOD OF CONTAINANT TO SEED OF FROM TO DATE: VIELD: GPM FROM TO DATE: D	NUMBER: 0114 MANAGER: Allan Jenluns	CASING
DEVELOPMENT SIZE WELL TO DATE: OFFICIAL OF FROM TO DATE: OFFICIAL OF FROM TO DATE: OFFICIAL OF FROM TO DATE: OFFICIAL OF FROM TO DATE: OFFICIAL OF FROM TO DATE: OFFICIAL OFFICIAL OFFICIAL OFFICE OFFI	ex: G. Millar 184:	
EQUIPMENT TO SEVELOPMENT SEAL OR SEAL	NAME: MW 209 10/20/95	
EQUIPMENT STATE INCH HOLLOW STEM AUGH DEVELOPMENT SEAL OF SEAL	COMPANY: Tri State Testing Services	tofeet
GALLONS OF WATER PROMETED GALLONS GALLONS OF WATER PROMETED GALLONS DEVELOPMENT SLE WIGHT TOWN. DEVELOPMENT SLE WIGHT TOWN. DEVELOPMENT SLE WIGHT TOWN. DEVELOPMENT TO DATE: SEAR CREMENTSAND BELLONG TOWN CASING AT THE BORRENT TO DATE: VIELD: GPM FROM TO DATE: VIELD: GPM FROM TO DATE: VIELD: GPM FROM TO DATE: SEAR CREMENTSAND BENTONITE PELLETS J. INCH DIAMETER SEARCH CREMENT SAND SEARCH CREM	EQUIPMENT: A 714 INCH HOLLOW STEM AUGER T Crawford	
DEVELOPMENT S.L. WELL TOURS OF COMMENTS OF CALLONS DEVELOPMENT S.L. WELL TOURS OF COMMENT	10" OVERATION TOTAL HOURS	
DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT DEVELOPMENT SLE WELL TOUR DOPPORT THE: DEVELOPMENT SLE WELL TOUR DOPPORT THE: THE: DEVELOPMENT SLE WELL TOUR DOPPORT THE: DEVELOPMENT SLE WELL TOUR DOPPORT THE: DEVELOPMENT SLE WELL TOUR DOPPORT THE: DEVELOPMENT SLE WELL TOUR DOPPORT THE: DEVELOPMENT SCHEDING DEVELOPMENT SLE WELL TOUR DATE: DEVELOPMENT SCHEDING DEVELOPMENT SLE WELL TOUR DATE: DEVELOPMENT SCHEDING DEVELOPMENT SLE WELL TOUR DATE: DEVELOPMENT SCHEDING DEVELOPMENT SLE WELL TOUR DATE: DEVELOPMENT SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHED SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SLE WELL TOUR SCHEDING DEVELOPMENT SACKS OF POWDERED BENTONITE DETAIL TOUR SCHEDING SCHEDING SCHED DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SAND GENEROLES DEVELOPMENT SCHEMENT SCHEMENT SCHEMENT SCHEMENT SCHEMENT SCHEMENT SCHEM	GALLONS OF WATER USED DURING DRILLING: 5 GALLONS FOT hydra	tionleet
DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DEVELOPMENT SLE WOLL TO VOLD MATERIALS USED DESCRIPTION SACKS OF POWDERED BENTONITE TO SACKS OF POWDERED BENTONITE PELLETS I S WOLL OLD SCHOOL	METHOD OF DECONTAMINATION FRIOR TO DRILLING: SLEOW (100 M) NO	TOP OF CASING AT
DEVELOPMENT: DEVELOPMENT: DEVELOPMENT: DEVELOPMENT: SECAN DAYE: TIME. VIELD: GPM FROM TO DATE: JECAN DAYE: VIELD: GPM FROM TO DATE: JECAN DAYE: VIELD: GPM FROM TO DATE: JECAN DAYE: VIELD: GPM FROM TO DATE: JECAN DAYE: VIELD: GPM FROM TO DATE: JECAN DAYES JECAN DAYES JECAN	<u> </u>	2.7" FEET ABOVE AT
BORHOLE O 10 17 Jeet DATE: VIELD: GPM FROM TO DATE: SEAL OR BENTONITE-CEMENT SEAL OR BESACK CEMENT-SAND SEAL OR SEAL OR BENTONITE PELLET SEAL OR SEAL OR BENTONITE PELLET SEAL OR SEAL OR SEAL OR BENTONITE PELLET SEAL OR	METHOD OF	
VIELD: GPM FROM TO VIELD: GPM FROM TO DATE: VIELD: GPM FROM TO DATE: VIELD: GPM FROM TO DATE: GPM FROM TO GENTONITE-CEMENT. SEAL OR GENTONITE-CE	DEVELOPMENT	BOREHOLE
TIME: GPM FROM TO VIELD: GPM FROM TO VIELD: GPM FROM TO VIELD: GPM FROM TO VIELD: GPM FROM TO VIELD: GPM FROM TO DATE: GPM FROM TO GEATONITE-CEMENT SEAL OR GEAL OR	YIELD: TIME: DATE:	
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DESCRIPTION OF TURBIDITY OF TUR		SEAL OR
BENTONITE PELLET SEAL (LISO 13 15 1 test MOD. TURBID VERY MUDDY ODDR OF WATER WATER DISCORDER SEWERS STORAGE TANK DORUMS ODTHER DEFTH TO WATER AFTER DEVELOPMENT: FEET FEET DORUMS OFFICE SAND PACK 13.5 10 27 Seet SAND PACK 13.5 10 27 Seet SAND PACK 13.5 10 27 Seet SAND PACK 13.5 10 27 Seet SAND PACK SAND PACK 13.5 10 27 Seet SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK 13.5 10 27 Seet SAND PACK SAND		
SEAL 11.50 3.5 1	OF TURBIDITY CLEAR SLIGHTLY CLOUDY	****
MATERIALS USED OHTLE 95 GAGONWELL SACKS OF MOVIE SAND JOING FINANCE SACKS OF POWDERED BENTONITE TO SACKS OF POWDERED BENTONITE TO SACKS OF POWDERED BENTONITE TO SACKS OF BEST OF 2 INCH PVC BLANK CASING TO FEET OF 2 INCH PVC SLOTTED SCREEN YARD CEMENT SAND IREDI-MIXI ORDERED VARD CEMENT SAND IREDI-MIXI ORDERED VARD CEMENT SAND IREDI-MIXI ORDERED NOT 10 SCALE TO YARD CEMENT SAND IREDI-MIXI ORDERED NOT 10 SCALE TO STORM SEWERS STORAGE TANK TO SACKS OF MOVIE SAND IREDI-MIXI ORDERED TO SACKS OF POWDERED BENTONITE TO POUNDS OF BENTONITE PELLETS 1.5 BUCKEDS TO FEET OF 2 INCH PVC BLANK CASING TO FEET OF 3 INCH PVC BLANK CASING TO SCHENT SAND IREDI-MIXI ORDERED NOT TO SCALE	DEVELOPMENT:	SEAL
SACKS OF OUNDS OF BENTONITE SACKS OF POWDERED BENTONITE SACKS OF POWDERED BENTONITE TO SACK		
DRUMS OTHER DEPTH TO WATER AFTER DEVELOPMENT: FEET MATERIALS USED OHILG 95 GA CONWELL IO SACKS OF Movie Sand 20/40 Filtranting media SACKS OF CEMENT SACKS OF CEMENT SACKS OF POWDERED BENTONITE TO POUNDS OF BENTONITE PELLETS 1.5 DUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING YARD CEMENT SAND (REDI-MIX) ORDERED YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE	DISCHARGED GROUND SURFACE TANK TRUCK	SAND PACK
SLOTTED (1010) MATERIALS USED 10 SACKS OF Morie Sand 20140 FI Hranting media SACKS OF Morie Sand 20140 FI Hranting media SACKS OF Morie Sand 20140 FI Hranting media SCHEDULE 40 PVE S.S. BLANK SILT TRAP SCHEDULE 40 PV	DSTORM SEWERS DSTORAGE TANK	
MATERIALS USED 10 SACKS OF Movie Sand 20/40 Filtranting media SACKS OF CEMENT SACKS OF CEMENT SACKS OF POWDERED BENTONITE The sacks of powdered bentonite The sacks of powdered bentonite pellets 1.5 buckeds 15.5 FEET OF 2 INCH PVC BLANK CASING TO FEET OF 2 INCH PVC SLOTTED SCREEN YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE INCH DIAMETER SCHEDULE 40 PVC SLED BLANK SILT TRAP 25.5 to 27.5 feet BOTTOM WELL CAP 27.5 feet BOTTOM OF BOREHOLE BOTTOM OF BOREHOLE NOT TO SCALE	DEPTH TO WATER]) } {
OHILGES GAGONWELL SACKS OF Movie Sand 20/40 FI Hranship readia SACKS OF CEMENT SACKS OF CEMENT SACKS OF POWDERED BENTONITE SACKS OF POWDERED BENTONITE SACKS OF POWDERED BENTONITE TO POUNDS OF BENTONITE PELLETS 1.5 BUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING TO FEET OF 2 INCH PVC SLOTTED SCREEN YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE		inch: SCREEN
SACKS OF Movie Sand 20/40 FI Hransand redia SCHEDULE 40 PVE S.S. BLANK SILT TRAP 255 to 275 feet BOTTOM WELL CAP 275 POUNDS OF BENTONITE PELLETS 1.5 DUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING 10 FEET OF 2 INCH PVC SLOTTED SCREEN 275 POUNDS OF BENTONITE PELLETS 1.5 DUCKES 15 of 2 INCH PVC BLANK CASING 275 Inch BOTTOM OF BOREHOLE 275 feet NOT TO SCALE	OUTLAS GAGONWELL	
SACKS OF CEMENT OHR GALLONS OF GROUT USED SACKS OF POWDERED BENTONITE TO POUNDS OF BENTONITE PELLETS 1.5 DUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING TO FEET OF 2 INCH PVC SLOTTED SCREEN THE PROPERTY OF SENTENCE SENTED SCREEN YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE	10 sacks of movie Sand 20/40 Filtrantion media	SCHEDULE 40 PVE 5.57
SACKS OF POWDERED BENTONITE 75 POUNDS OF BENTONITE PELLETS 1.5 BUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING 27.51=e1 BOTTOM OF BOREHOLE 27.51=e1 BOTTOM OF BOREHOLE 27.51=e1 BOTTOM OF BOREHOLE YARD CEMENT-SAND (REDI-MIX) ORDERED NOT TO SCALE		
SACKS OF POWDERED BENTONITE 75 POUNDS OF BENTONITE PELLETS 1.5 DUCKES 15.5 FEET OF 2 INCH PVC BLANK CASING 10 FEET OF 2 INCH PVC SLOTTED SCREEN 2 FT of 2 INCH 5.5. SI I + trap YARD CEMENT-SAND (REDI-MIX) ORDERED NOT TO SCALE		BOTTOM WELL CAP
15.5 FEET OF 2 INCH PVC BLANK CASING 10 FEET OF 2 INCH PVC SLOTTED SCREEN 2 FT OF 2 INCH 55. SI I + trap YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE		
FEET OF 2 INCH PYC SLOTTED SCREEN 2 FT of 2 INCh 55. 511+ trap YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE		
2 PT of 2inch SS. Silt trap YARD CEMENT SAND (REDI-MIX) ORDERED NOT TO SCALE		
VADD ³ CELENT SAND (DEDLAWY 1955)	FEET OF 2 INCH PYC SLOTTED SCREEN	BOTTOM OF BOREHOLE
VADD ³ CELENT SAND (DEDLAWY 1955)	vand arrest and	
ADDITIONAL INFORMATION:	YARD CEMENT SAND (REDI-MIX) ORDERED	
001/00/200		ADDITIONAL INFORMATION:
y .	CONCRETE PUMPER USED? DNO DYES FOR growt	
carculard grows 45,08 and	WELL COVER USED: MOCKING STEEL COVER	carculated grout= 45,08 gal
□ CHRISTY BOX	CHRISTY BOX	

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW211

SHEET / OF 2

CORPORATION																
PRO.	JECT:			EAK	ER A	\FB	RFI		JOB	NO.		जान.	BORING/WELL N	0.: Mn	RII	
									LOG	GED	BY: C	a. Millar	TOTAL DEPTH O	F BOREHO	OLE:	
DRIL	LING	CONT	RACT	OR:		Tri-S	State	Testi	ng			SURFACE ELEV.:		DATUM:		
DRIL	LER'6	NAM	E:	Jol	20	C	ro	س	for	d			0900	DATE:		
DRIL	L RIG	TYPE	:	CM	E-	7	5					FINISH TIME:	800	DATE:	811	5195
BOR	ING M	ETHO	D: 7	14"	4SA	0/	erd	rille	d W	110	" HSA	WATER DEPTH:		•		
	BORING METHOD: 7'14" HSA OVER DIRED WITO" HSA HOLE DIAMETER: 10"											DATE:				
SAMPLING METHOD: Continuous Samplina										ناد	na	TIME: '			•	
	MER			NA				P HGT	•		\sim	BACKFILLED, TIME:		DATE:	•	
SURI	surface conditions: Grassy, Patcheu											WEATHER: HOT; H	tumid: Su	nny	95°F	: 51+ bree
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LTHOLO QY	90 m 208 BIDC: 450	58211 MW211611	\	-	Spill Sik #1
													MATERIAL DESC	RIPTION		
5	3//0	NA NA	4=1	35	5/30 359 80/30	WE!	Sition	10 JK 412	ALYTICAL SAMPLES	3 4 5 6 7	SUMM	clay fr dk gr 4.0'- 6.5' gray; noted: fill. 7.0'- 9.3' SILT;	eyish br - Clayer strong fi materia - Sitty (Strong fue crete a).01).	1 /00 LAY	dor dor dor cis	dk sheen like eyey dk gray
					50/ 50/ 50/ 50/			icyr 513	AB AN	9	SM	well so	grained vted; brr l; Sheeh e of wa	not	lt. e	on

NOTES: To de termine concentration of Contaminant EDITED BY/DATE: at the potentially most contaminant portion of the plume.



FIELD LOG OF BORING

WELL NO. <u>ALW 211</u>
SHEET 2 OF 2

	CORPORATION									T								
PRO.	ROJECT: EAKER AFB RFI											JOB NO.: 0114 BORING NO.: MM						
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET		итн.						
		1	11			SAT	1005	10YR			Ц		barrell.	·				
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										"	П							
13		H	5=1	157	206/	-			6	13		5 M						
					20/2				PLE									
									SAMPLE	14								
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NOTES:______ EDITED BY/DATE:_____

FIELD HELL	COMPLETION	FORM			CHRISTY BOX	I
JOB FO	Jear AFR				LOCKING STEEL COV	ER
101	Jewr MIC	PROJECT			INCH DIAMETER	٦
NUMBER:	114	MANAGER: A	llan Jenkins		STEEL CONDUCTOR CASING	
EY: 6.	Millar	EDITED BY:			tofeet	
MAME: MW	20		8115195		BOREHOLE	`
COMPANY: TH	i State T	estina			tofeet	
EQUIPMENT:			Services		BENTONITE CEMENT	
Ø .		OW STEM AUGER	111 01 0000		SEAL OR	
0.	INCH ROTA	RY WASH	HOURS DRILLED:		8 SACK CEMENT SAND	'
GALLONS OF WA	TILLING:		GALLONS		tofeet	
METHOD OF DEC PRIOR TO DRILL	ontamination in Steam	cleanino	<u> </u>	. =	TOP OF CASING AT	
	Well Dev			111	SFEET ABOVE AT	.
METHOD OF		Clopiner	G FONTY		BELOW CHOUND LEVE	-
DEVELOPMENT:					BOREHOLE	
BEGAN DATE:		TIME:			0 :0 21 1ees	
GPM	FROM TO	0	DATE:		2 INCH DIAMETER	
YIELD: GPM	TIME:	•	DATE:		SCHEDULE 40 PVC	
YIELD:	TIME:		DATE:		BLANK CASING O to 9 feet	- 1
GPM YIELD:	FROM TO)				-
	FROM TO		DATE:		SEAL OR	
TOTAL WATER REDURING DEVELOR	MOVED		CALLONS		6-SACK CEMENT-SAND	
DESCRIPTION OF TURBIDITY			GALLONS		0 10 5 feet	
AT END OF DEVELOPMENT:	CLEAR	∐ SL1	GHTLY CLOUDY		BENTONITE PELLET	
-	☐ MOD. TURB	D D VEF	RY MUDDY		SEAL SEAL	1
ODOR OF WATER					5 :0 7 'eet	
WATER DISCHARGED	GROUND SURFA	CE TANK T	RUCK		SAND PACK	-
TO:	☐STORM SEWERS	□ STORA			7 10 21 1ees	
	DRUMS	OTHER.				
DEPTH TO WATER AFTER DEVELOPM	ENT:	F	EET		SLOTTED (. O O	
MATERIALS USE	D				inch: SCREEN	1
	072495 6	4 DONNELL			9 to 19 feet	
SACKS	OF Moire 201-	lo Fi Hration	Media saun		2 INCH DIAMETER	
SACKS	OF		CEMENT		SCHEDULE 40 PVCSS. BLANK SILT TRAP	
20 GALLO	ONS OF GROUT USE		CEMENT		19 to 21 feet	
					BOTTOM WELL CAP	
TE-O-ML	OF POWDERED BE	NTONITE			21 feet	
POUNT	S OF BENTONITE P	ELLETS 11/2	bur Kefs		HOLE CLEANED OUT TO	
FEET (OF INCH PVC I	BLANK CASING.	01 1-00	· .	21 1981	
FEET C	F _ INCH PYES	LOTTED SCREEN	1		BOTTOM OF BOREHOLE	
2 7-T c	it 2 inch s	S. 511+	trap		21 leet	
YARD ³	CEMENT-SAND (RE	DI-MIXI ORDERE	ID	NOT TO SCA	.LE	
YARD3	CEMENT-SAND (RE	DI-MIXI USED	.***			
ONCRETE PUMPER		☐YES			L INFORMATION:	
	linas				ated sand=10.92s	
YELL COVER USED:	'MLOCKING STEE	L COVER		Calcul	ated grout = 19.6 go	le
	CHRISTY BOX	- JOYEM				
	OTHER					
						1

3/18/96 DATE: AFCEE/Eaker AFB CLIENT: JOB NUMBER.: 726876.68230 ELEVATION: Z-inch BORING DIA.: Building 457 Area SITE: DATUM: CONTRACTOR: 457-SB1 Parsens EJ BORING NUMBER: GEOLOGIST: D. Teets WEATHER: vcldy, windy RIG TYPE: Geophobe DRLG MED: ~40°F TEMPERATURE (°F):

				' / J	0.11	T all a material			
I					Split	Laboratory	C1a	PID	Remarks
'	Depth	Pro-	USCS		Spoon	Sample	Sample		Remarks
١	(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
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	3								
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	7	ĺ		- 01 d	/	†			091 PID=Z.0/Z.0
				7-91 (lsy, V Silty, trin, 39tor flow, MB					
	8	1		7-91 Clay, v silty, tron, saturated, nos	ΙX		1		
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	16	-			1		1		
1		-			1				
	17	-			1				
		-	-		1				
	18	1			1				
	10	-	1		1				
	19	1			1				
	20	1			1		<u> </u>		
	20								

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

		GEOLO	GIC BORI	YG L	\mathbf{OG}			
JOB NUMBER.:	726876.68230	CLIENT:	AFCEE/Eaker AFB			DATE: ELEVATION:	<u> 3/18/96</u>	
SITE:	Building 457 Area	BORING DIA.: CONTRACTOR:	Parson Es			DATUM:		
BORING NUMBER: RIG TYPE:	457-5B2 Georrobi	WEATHER:				GEOLOGIST:	D. Teets	
TEMPERATURE (°F):	~40°F	DRLG MED:	Direct Rish			_		
COMMENTS:	Exploratory	only (200	northwest of	TWIST	94)	-		
	1			Split	Laboratory			

		T			Split	Laboratory			
B 1	epth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
	ft.)	file	0505	Geologic Description	Interval	Identification	Туре	ppmv	
	11.)	1110							
	1								
	2								
	3				ļ		l	1	
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	4				1				
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	5			10/ 11/ 10/11/	7				
				5-6: Clay v silty, to sand, f, brn, moist	1				P6 PID=1.4/1.4
5	6			6-7' SAA except wet	łΧ				
-	7			6-7 SAA, EXCEPTION	1/ \	<u> </u>		ĺ	e7' PID=1.6/1.4
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PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

					- 1 /
IOD WID OFF	726876,68230	CLIENT:	AFCEE/Eaker AFB	DATE:	31/8/96
JOB NUMBER.:	720070:00250	BORING DIA.:	7-1-1	ELEVATION:	
SITE:	Dunding 157 11111		13-inch	DATUM:	
BORING NUMBER:	457-5B3(MB-5)		Tarsons Es	GEOLOGIST:	D. Teets
RIG TYPE:	Geophore	WEATHER:			D. 1000
TEMPERATURE (°F):		DRLG MED:	Direct Push		

	Depth (ft.)	Pro-	uscs	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
	1	Ino							
	2								
	3			·					
	5								
	6			5-7/tys 1 Silt claps ytr son, f, brun, gray staining, strong petroloun odor, moist					
n -	7			7-8's Silt, Kelaxer, moist, gray staming	$\langle \cdot \rangle$				071 PID 254/2,0
	8			8-8.5 Clay, v sily v. moist, grn, gry	X				08.5 PID=10/2.0
	10			Strining, Strong Alt, Oder					
	11								
	12				-				
	13				1				
	15								
	16				1				
	17	1			1				
	19				-				
	20	1			1		<u> </u>		

PID - Photoionization Detector

BH - Borehole

ft - Feet

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

			VAV. A. V. A		, ,	
JOB NUMBER.:	726876.68230	CLIENT:	AFCEE/Eaker AFB	DATE:	3/19/96	
SITE:	Building 457 Area	BORING DIA.:	Z-inch	ELEVATION:		
BORING NUMBER:	457-SBY (MPA-5)	CONTRACTOR:	Parsons ES	DATUM:		
RIG TYPE:	Coeprobe	WEATHER:	st cldy, windy	GEOLOGIST:	D. Teets	
TEMPERATURE (°F):	~ 40°F	DRLG MED:	Direct Push			

				Split	Laboratory	1		
Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
(ft.)	file	0505	Geologic Description	Interval	Identification	Type	ppmv	
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4]			{				
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5	ļ							OF DID=ZU/IO
			5-6,5': Clay, silty, torn, moist, gray styring, strong petrolem now:	{ \				05' PID=24/1.0 TAVA =84ppm
6	1		Contamination Starts at about Siz bas			Ì		7//
7	ł		Contamiliation) Tarl 47-2017 SIE 193					
<u> </u>	1		7-9'1 SAA, exept wet	1				
8	1		7 1 30 , 800 00 00] \ /	·			07' PID = 10,5/2.0
	1]				
9	1							
]		9-11 ! SAA except saturated	\ /	!			PIL PID=12,6/1.8
10				X				BIL PIDEICIONIO
				$/ \setminus$				
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20	1			<u> </u>		<u></u>		

PID - Photoionization Detector

BH - Borehole

ft - Feet

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

										Sheet 1 of 1
				GEOLO	GIC BORI	NG L	\overline{OG}			
JOB NU	лмвек.:		726876.68230	CLIENT:	AFCEE/Eaker AFI			DATE:		3/19/96
SITE:			Building 457 Area	BORING DIA.:	Z-inch			ELEVAT		
	G NUMI	BER:	457-585	CONTRACTOR:	Parsons ES			DATUM GEOLOG		D. Teets
RIG TY	PE: RATUR	E (°E).	Coproke	WEATHER: DRLG MED:	Direct Push			_GLOLOC		D. Tools
COMM		E(I).	No monitor	ing point inst				_		
			710 1-01112	31-31-						1
						Split	Laboratory Sample	Sample	PID	Remarks
Depth	Pro- file	USCS		Geologic Description	,	Spoon Interval	Identification	Туре	ppmv	
(ft.)	THE			Geologie Description				1		
1										
2										
3										
_										
4										
-			4-6 1 Clay, si	lty, sm sand, f	-m, brn/sm					,
5			5rx12	1015, SI STSINIA	J; 110 mov	X			e45	PID=2,8/1.6
6					,					
			6-7': SAA exc	ept nosand, w	el .	\times	•			e6.5 PID-2.3/1.6
7										COLD FIRE ELECTION
8										
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10										
•										
11										
12									-	
13										
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16										
17										
18	1									
19	1									

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

HSA - Hollow Stem Auger ft - Feet

Bkgrnd - Background

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

DATE: AFCEE/Eaker AFB CLIENT: JOB NUMBER.: 726876.68230 ELEVATION: BORING DIA .: Building 457 Area SITE: DATUM: CONTRACTOR: BORING NUMBER: 457-580 (MPC-45 D. Teets GEOLOGIST: WEATHER: RIG TYPE: Georghe DRLG MED: TEMPERATURE (°F): 40°F

Depth	Pro-	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
(ft.)	file		Geologic Description					
1								
2								
3								
4			4-5.5 1 Clay silk trisandit, gravion	7		:		
5			4-5.5 1 Clay, silty, tr. sand, f, gray, bin staining, sl. petrolem odar, mit	\triangle				11.000.10/
6			6-8': SAA except wet, loss sand	1				06' PID=1.8/1.0 7/1/4A=130pm e7.5' PID=20.0/1.2
7			16-3 · 574 (xxp) (xx.) (33.51-1	X				P7.5'PD=20.0/1.2 7HA=180pp~
8								,
9								
10								
11								
12								
13								
14								
15								
16								
17	1							
18								
19	1							
20	1							

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

Halliburton NUS

FIELD LOG OF BORING

WELL NO. TW'1501

SHEET __ / OF 2 CORPORATION 0114 BORINGWELL NO .: TW1501 JOB NO.: **EAKER AFB RFI** PROJECT: TOTAL DEPTH OF BOREHOLE: LOGGED BY: G. Millar SURFACE ELEV.: DATUM: DRILLING CONTRACTOR: Tri-State Testing DATE: 8/27/9~ 1040 DRILLER'S NAME: Mark Tothy START TIME: DATE: 8/27/95 1120 DRILL RIG TYPE: CME-55 FINISH TIME: BORING METHOD: 7/4" HSA WATER DEPTH: HOLE DIAMETER: 71/4" DATE: SAMPLING METHOD: Continuous Sampling TIME: BACKFILLED, TIME: DATE: DROP HGT: NA HAMMER WGT.: NA WEATHER: Sunny; Hot : breezy 88°F surface conditions: Grassi, some gravel LAB SAMPLE NUMBER SAMPLE TYPE BLOWS / 6-INCHES OVA READING (ppm) BLDG NCHES RECOVERED SAMPLE INTERVAL INCHES DRIVEN MUNSELL COLOR LITHOLOGY DENSITY 1504 OTW 1503 SKETCH OF BORING LOCATION MATERIAL DESCRIPTION * Lithology for this temp well begins at 8.0'. Lithology from 15-8.0' is similar to that of TWSHOM TWISOHL from Soil cuttings). See page 2 for lithology. र्द्ध भार NIO 5M

NOTES: To determine extent of contamination EDITED BYIDATE:

(from UST at Bldg 457.



NOTES:

FIELD LOG OF BORING

WELL NO. TW 1501

SHEET 2 OF 2

B.O'- 13.0' - Sandy SILT; Some Sand is vfg AK yellowish brown. 13.5 3.6 0 Web and is vfg AK yellowish brown. 14. ML Sand is vfg Sand; more sand from 14.5-16.00 Sand is vfg, Well sorted; has a laminated apprairate why loyer the mothing lak yellowish brown. Color change to greenish grey a 15.5; Less sand below	PRO	ECT:	ECT: EAKER AFB RFI).:	0114 BORING NO .: TW , 501
B.O'- B.O' - Sandy SILT; Sity SAND; Some Clay, Sand is Vfg Clay yellowish brown. 13 13.0'- 16.5' - Clayey SILT; Some Sand, more sand from 14.5-16.0' Sand is Vfg, Well Soveted; has a laminated appearance w/ 10yr 4/16 mething ldk yellowish brown. Color change to greenish grey D. 15.5'; Less sand below 14.0'; rootlets worm burrows Prom 13.0'- 16.0', No mothing arm below 16.0'.			-					DENSITY	COLOR	SAMPLENUMBER	N FEET	ATT ASSESSED TO THE REAL PROPERTY OF THE PER		
	-			3.5	1	%		200	Gey		11 12 13 14 15 16		14	SAND; some clay, sand is vfg alk yellowish brand. 13.0'- 16.5' - clayey SILT; some sand, more sand from 145-16.0; sand is vfg, well soved; has a laminated appearance wy roye 416 mothing lak yellowish brow) Color change to greenish grey D 15.5; Less sand blow 16.0'; rootlets worm burrows from 13.0'- 16.0'; No mothing arm below 16.0'.

EDITED BY/DATE:_



FIELD WELL COMPLETION	N FORM	CHRISTY BOX
NAME: Eaker AFE	2	O LOCKING STEEL COVE
NUMBER: 0114	PROJECT HILAN Jenkins	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED G. Millar	EDITED BY:	
WELL NAME: TWISOI	PATE: 8127/95	BOREHOLE
DRILLING	esting Services	tofeet
FOLLIAM FMT: 4	LLOW STEM AUGER M. Tothy	BENTONITE CEMENT
_	TARY WASH HOURS	B-SACK CEMENT-SAND
GALLONS OF WATER USED DURING DRILLING:	5 GALLONS	tofeet
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	eam Cleaning	TOP OF CASING AT
	Development Form	3 FEET ABOVE AT
METHOD OF DEVELOPMENT:		7/4 INCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:	BOREHOLE D to 16 15 feet
TIME: GPM FROM	TO DATE:	2 INCH DIAMETER
YIELD: TIME:	TO DATE:	BLANK CASING
YIELD: TIME: GPM FROM	TO DATE:	+3 to 6 feet
TIME: GPM FROM	TO DATE:	SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS	8-SACK CEMENT-SAND
DESCRIPTION OF TURBIDITY CLEAR AT END OF	SLIGHTLY CLOUDY	ro feer
DEVELOPMENT: MOD. TU	RBID VERY MUDDY	BENTONITE PELLET SEAL
ODOR OF WATER:		0 :0 4 reel morie 20/40 00N
DISCHARGED GROUND SUF		SAND PACK
DRUMS	RS STORAGE TANK	4 10 16.5 teet
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED (_ 1010
MATERIALS USED		inch: SCREEN 6 to 16 feet
5' 3/4 SACKS DE	SAND	INCH DIAMETER
NA SACKS OF	CEMENT	SCHEQULE 40 PVC BLANK SLT TRAP
LA GALLONS OF GROUT (JSED	10leet
NA SACKS OF POWDERED	BENTONITE	BOTTOM WELL CAP 16-0 leet . 5' Sand
75 POUNDS OF BENTONIT	EPELLETS 1.5 buckets	HOLE CLEANED OUT TO
	VC BLANK CASING 1 Ft of cut of	F. 1 <u>16.5</u> 1 net
10- FEET OF 2 INCH P	C SLOTTED SCREEN	BOTTOM OF BOREHOLE
YARD CEMENT-SAND	(REDI-MIX) ORDERED	NOT TO SCALE
YARD CEMENT-SAND	(REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? DE		calculated sand = 6.25 boss
NAME		
YELL COVER USED: LOCKING S	TEEL COVER	
OTHER_	Temp Well	

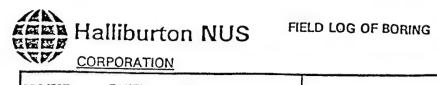
Halliburton NUS

FIELD LOG OF BORING

WELL NO. TW 1502

SHEET 1 OF 2 **CORPORATION** PROJECT: EAKER AFB RFI JOB NO .: 0114 BORING/WELL NO .: TW1502 LOGGED BY: B. MCCANCESS TOTAL DEPTH OF BOREHOLE: 18.5 DRILLING CONTRACTOR: Tri-State Testing SURFACE ELEV .: DRILLER'S NAME: MARK TOTTY START TIME: 0926 DATE: 8/28/95 DRILL RIG TYPE: CME 55 FINISH TIME: 1021 DATE: 8/28/95 BORING METHOD: 714" HS A WATER DEPTH: HOLE DIAMETER: 7 14" DATE: SAMPLING METHOD: SPLIT BARREL WILINERS HAMMER WGT.: NA DROP HGT: NA BACKFILLED, TIME: WEATHER: CLEAR BREEZE 80'S SURFACE CONDITIONS: VEGATATION TWIST SAMPLE TYPE BLOWS / 6-INCHES OVA READING (ppm) NCHES RECOVERED SAMPLE INTERVAL MOISTURE
DENSITY
MUNSELL COLOR INCHES DRIVEN BLDG 457 TWISD3 1 SKETCH OF BORING LOCATION MATERIAL DESCRIPTION gravel, roots polo brown very dark gray atlic' 3,5-9,5' SILT trace ufg sand, dark yellowish brown 2' 2' 3/ WETSOFT 9.5-11.5 Sandy SILT, Sundis vfg darkyellowish brown no odor

NOTES: DETERMINE PRESENCE OR ABSENCE EDITED BY/DATE: OF CUNTAMENATION



NOTES:

WELL NO. TWIS 02

SHEET 2 OF 2

SAMPLE TYPE BLOWS / 6-INCHES BLOWS / 6-INCHES BLOWS / 6-INCHES BLOWS / 6-INCHES BOUNDER OVA (PPM) MOISTURE DEPTH IN FEET LITH. A COLOR SAMPLE LYPE DENSITY COLOR LITH. A COLOR DEPTH IN FEET LITH.	TWISCZ
AL I G-INCHES DRIVEN NUMBER N FEET	
SAMPLE TYPE BLOWS / 6-INC INCHES DRIVE! RECOVERY OVA (PPM) MOISTURE DENSITY COLOR SAMPLE NUMB! DEPTH IN FEET LITH.	
10 SB NA S' Y' 0/0 SATSOFT 100x 11.5-15.5 S. 14. CLAY gray Same oreas claye, STLT CL CL Couts at 12.5' (3.5-14' 2.5 yR mattle (15.5-18.5' CLAY trace s. 14' DL greenish grey 5. R 414 (re. Brown) mattles' cratstructur Slightly, plastic TD-18.5' TD-18.5'	red)

_ EDITED BY/DATE:_



FIELD WELL COMPLE	TION FORM	•		CHRISTY BOX
NAME: EAKER AF	a			D LOCKING STEEL COVER
NUMBER: 0114	1220122	ILLAN JENKINS	41-17-	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED B, MC(ANLE.	EDITED			toleet
WELL TW1502		8/28/95		- INCH DIAMETER
DRILLING TRI STA	TT TT T. I.C.	0126145		BOREHOLE .
EQUIPMENT: //	H HOLLOW STEM AUGE	DRILLER:		BENTONITE-CEMENT
	H ROTARY WASH	HOURS		SEAL OR BISACK CEMENT-SAND
GALLONS OF WATER USED DURING DRILLING:	S	ORILLED: 1		II. SEAL -
METHOD OF DECONTAMINAT	ION	GALLONS		
DEVELOPMENT	STEAM	CLEAN		TOP OF CASING AT
METHODOE				BELOW GROUND LEVEL
DEVELOPMENT	DEVELOPME	NT FORM		THY INCH DIAMETER
YIELD: TIME:	TIME:	DATE:		0 :0 18.5 feet
GPM FROM	то			SCHEDULE 40 PVC
GPM FROM	TO .	DATE:		BLANK CASING
GPM FROM	то	DATE:		+2 to 8 feet
GPM FROM	то	DATE:		SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS		SEAL SEMENT-SAND
OF TURBIDITY CLEA	AR DSL	IGHTLY CLOUDY		to feer
DEVELOPMENT:	. TURBID V	ERY MUDDY		BENTONITE PELLET
ODOR OF WATER:				0 10 6 feet morse (0. 20140
WATER DISCHARGED GROUND		TRUCK		SAND PACK
STORM S	EWERS STOR	AGE TANK		6 1018,5 feet
DEPTH TO WATER AFTER DEVELOPMENT:	. DOTHE	FEET .		SLOTTED (DIO)
MATERIALS USED		FEET		inch : SCREEN
S seems mod		oi F and		B to 18 feet
A (4)		RATEONSAND		SCHEDOLE 40 PVC
A/A		CEMENT		BLANK SPLT TRAP
U.A. GALLONS OF GRO			4	BOTTOM WELL CAP
On POWDER		D		<u>18</u> feet
10 FEET OF 2 INC	ONITE PELLETS 1.3	64 BUCKETS		HOLE CLEANED OUT TO
10 FEET OF 2 INC	H PVC SLOTTED SCRE	j 		
	VC 3EOTTED 3CRE	EN		BOTTOM OF BOREHOLE
YARD ³ CEMENT-SA	ND (REDI-MIX) ORDE	RED	NOT TO SCALE	
YARD3 CEMENT-SA	ND (REDI-MIX) USED			NFORMATION:
ONCRETE PUMPER USED?	MO TES			TED SANDE
IAME			6.25	
VELL COVER USED: LOCKIN	NG STEEL COVER			0.703
MOTHER DENKIST	TEMPURARY	WELL		

Halliburton NUS

FIELD LOG OF BORING

WELL NO. TWISC3

SHEET _ j_ OF _ a_

CORPORATION BORINGWELL NO .: TW 1503 0114 PROJECT: EAKER AFB RFI JOB NO.: TOTAL DEPTH OF BOREHOLE: 161 G. Millar LOGGED BY: DATUM: SURFACE ELEV .: DRILLING CONTRACTOR: Tri-State Testing DATE: 8/27/95-1730 START TIME: DRILLER'S NAME: Mark Tothy DATE: 8/27/95 1900 FINISH TIME: DRILL RIG TYPE: C.ME 55 BORING METHOD: 7'14" IHSA-WATER DEPTH: HOLE DIAMETER: 714" DATE: SAMPLING METHOD: Continuous Sampling TIME: BACKFILLED, TIME: DATE: DROP HGT: N)A WEATHER: 80'5-90'5 SURFACE CONDITIONS: Grass PCAD Barking LAB SAMPLE NUMBER DVA READING (ppm) NCKES RECOVERED BLOWS / 6-INCHES SAMPLE INTERVAL MUNSELL COLOR BLDG . DEPTH IN FEET SAMPLE TYPE 457 LITHOLOGY old tank @TW1503 DENSITY @ TW 1504 corrosion SKETCH OF BORING LOCATION Control MATERIAL DESCRIPTION 5'- 18' Sandy SILT, Vfg angular well sorted giz. some pea gravel, dk utilowish brn. 5,0'-6.8' - Sandy SILT; w/ 10 yR416 mothing dk.yellowis trace clay/natura 75.3 Color change 2FT 2FT (13) (13) 90 laminated 10.5 - 12:01: some rootlets present.

NOTES: To determine presence irrabsence of EDITED BYDATE:

EDITED BY/DATE:____



NOTES:

FIELD LOG OF BORING

WELL NO. TW 1503

CORPORATION BORING NO .: TWI503 JOB NO.: 0114 PROJECT: EAKER AFB RFI BLOWS / 6-INCHES SAMPLE'NUMBER INCHES DRIVEN DEPTH IN FEET SAMPLE TYPE OVA (ppm) RECOVERY MOISTURE NTERVAL DENSITY COLOR LITH. 12.0' - 14.0' - Claver SILT: NA SPT SFT 3/ wio some Vfg, Well sorted, saind کنور را Some rootlets: plastic; Grey 12 10 YE SII ML 14.0'-15,0' - Silty CLAY, root 13 casts + worm burrowsfilled with 5 y R 4/6 yellowish red 14 silty material. Overall color Grey: 51+ plastici ċĹ 15 15 15 0 15,0'-16.0' - looged by cuttings (same as 14.01-15.0' lithology) TD = 16'

EDITED BY/DATE:



FIELD WELL	COMPLETION FOR	RM	•			CHRISTY BOX	
JOB						LOCKING STEEL COVER	
JOB NUMBER: Oll	KEY BFB	JECT Allan	Tenleins	41-5	7-1	INCH DIAMETER STEEL CONDUCTOR CASING	
LOGGED	EDI	TED	<u>5646.</u> (5			tofeet	
WELL	-(11(0)					INCH DIAMETER	
DRILLING	11503	_	37195			BOREHOLE	
COMPANY: Tri	state Testi					to feet	
EQUIPMENT:	7/4 INCH HOLLOWS	TEM AUGER DRILL	Tothy			BENTONITE-CEMENT SEAL OR	
ο.	INCH ROTARY V	VASH DHILL				- 8-SACK CEMENT-SAND SEAL	1
GALLONS OF WA	TER RILLING:	5 GALLO	ins to nydr	ate		tofeet	
METHOD OF DEC PRIOR TO DRILL				٠, ٦	7	TOP OF CASING AT	
DEVELOPMENT	see Well D	vevelopmen	+ Form			FEET BOYDAT	
METHOD OF DEVELOPMENT:	•	•			-	- 714 INCH DIAMETER	
DEVELOPMENT BEGAN DATE:	TIMI	t:		-		BOREHOLE O to 16 feet	
YIELD: GPM	TIME	DATE:				2	ĺ
YIELD:	TIME:	DATE:				SCHEDULE 40 PVC	
YIELD:	FROM TO	DATE				BLANK CASING	
GPM	FROM TO	DATE:			1.	- D BENTONITE-CEMENT	
GPM		DATE				SEAL OR SEAL OR S-SACK CEMENT-SAND	
TOTAL WATER REDURING DEVELO		GALLO	NS			SEAL	
DESCRIPTION OF TURBIDITY AT END OF	CLEAR	□ SLIGHTLY	CLOUDY	***	***	BENTONITE PELLET	
DEVELOPMENT:	MOD. TURBID	VERY MUE	DDY			SEAL	_ =
ODOR OF				3333	****	0 to 3.5 feet	المعمو
WATER DISCHARGED	GROUND SURFACE	TANK TRUCK		-	= +-	Maric 20/40 Cor	707
TO:	STORM SEWERS	STORAGE TAN	iK	=	=	3,5 1016.0 leer	
DEPTH TO WATER	DRUMS .	OTHER		=		2 INCH DIAMETER	
AFTER DEVELOP		FEET	•			SLOTTED (O/O/O)	
MATERIALS US	ED			=	=	5,5 to 15,5feet	
5 1/16 SACK	072495 6 05 of Movie 2014	OFiltration	udia.		-	SCHEDULE 40 PVC	
	s of		_CEMENT			BLANK SILT TRAP NA	
	ONS OF GROUT USED	•				10leet	
	S OF POWDERED BENTO	ONITE			_>≺	BOTTOM WELL CAP	
	IDS OF BENTONITE PELL		chite			15,5 leer is sand	
10 FFFT	OF 2 INCH PVC BLA	NK CAEING : CI	CRUIT ALL			HOLE CLEANED OUT TO	
10 FEET	OF 2 INCH PVC SLO	LLED CODEL	CILL OFF			- BOTTOM OF BOREHOLE	
	OF INCH PVC SLO	I LED SCHEEN		**************************************		16 feet	
	3 CEMENT-SAND (REDI-				SCALE		
YARD	CEMENT-SAND (REDI-	MIX) USED		ADDIT	ONALIA	IFORMATION:	
	·]YES				Send = 612 sacks	
NAME	,			SHALL	<u> </u>	was a said said	
WELL COVER USE	D: LOCKING STEEL	OVER					
	OCHRISTY BOX	o Well		-			

Halliburton NUS FIELD LOG OF BORING

WELL NO. TW1504 SHEET ____ OF ____

		CUI	POF	AII	714											
PRO.	JECT:			EA	CER A	AFB	RFI		JOB	NO.	.:	01	4	BORING/WELL N	0.:	
									LOG	GED	BY	: B	MCCANLESS	TOTAL DEPTH O	F BOREHOLE:	5.5'
DRIL	LING	CONT	RACT	OR:		Tri-S	State	Test					SURFACE ELEV.:		DATUM:	
DRIL	LER'S	NAM	E: N	n A	RK	TO	<i>T</i> T	V					START TIME: 142	8	DATE: 8/27	1195
1		TYPE											FINISH TIME: 1517		DATE: 8/27	195
BORI	NG M	ETHO	D: 7	14	" H	SA							WATER DEPTH:			
HOLE	DIA	METER	1:7	1/4"									DATE:			
SAM	CAMPLING METHOD: SPLIT BARREL WILINERS							LI	NI	ERS	TIME:					
	HAMMER WGT.: NA DROP HGT: NA									BACKFILLED, TIME:		DATE:				
SURF	ACE	COND	MON	is: L	/E	SA	r A	TIC	N				WEATHER: CLEA	RREEZ	E 90's	
SAMPLEINTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSEL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	THE THE CONTRACTOR OF THE PARTY	LITHOLOGY	TW 1501	BLOG: 457		N.
1884	2000	reste	728	terié		ite in the				10.0		7.7.1	1	MATERIAL DESCR	RIPTION	
0	SB	NA	5'	1.5'		ORY	اتوجو					G-C	0.5-3.5 FILL S. It matrix roots gravel + rock fragments			
	I.nes				10			514								
					0								yellowish brown			
				1							П					
1						П		П		-	П					
											П		3,5-8,5	ST	IT dos	k
						1	i	H		'>	Н					
						mst	MEO	קינו		,	H	mL	y ellowish		sane Vr	9,
						1		1	-	1	H		not plast	, C		
											Н					
5			3,	יג	0,		+	+	1 2	4	H					<u> </u>
Ĭ				lî	10				E.15-54-	\						
	-			-	2		-	-	u Z							
					%	WET	Serr									
+			+		1	SAT	+	-			H					
8						1					H		85-17 :	11. < 4	h/n <-	- v.f.
8		+-	2'	21	0/	1-	1	1		1	H		dk . 11 =	17 10 10 10 10 10 10 10 10 10 10 10 10 10	VU san	A VEG
Í				1	10							ML	8.5-13 s; dk. yellow; at 8 + 9.5'	1016W	n, mare	سرما ب
	$\dot{\top}$			-	0,	-	十	1					W 0 4 113	7 /10 / 016	N. 1. C	
10	1	1			10						H					

NOTES: DETERMENE PRESENCE UR ABSENCE EDITED BYDATE: OF CONTAMENATION



FIELD LOG OF BORING

well NO. TW1504

SHEET 2 of 2

		COR	PUR	AII	אנ								
PRO	JECT:		EAK	ER A	FB RF	1			·	JOB	NO.:	0114 BORI	NG NO .: TW1504
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY		MOISTURE	DENSITY	COLOR	SAMPLE'NUMBER	DEPTH IN FEET	LITH.		
15	58	NA	5	4'	% % %	SA+	S) Fr	ICYR 51.			OH	13-15.5' s; l+, CLAY G Sand, Slightly plastic TD-15.5'	Cay trace

NOTES:_____EDITED BY/DATE:____

FIELD WELL COMPLETION FORM	CHRISTY BOX
10E	D LOCKING STEEL COVE
NAME: FAKER AFB NUMBER: OILY MANAGER: ALLAN JENKI	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED B. MCCANLESS EDITED	tofeet
WELL TW1504 B/27195	INCH DIAMETER
OPILLING	BOREHOLE
COMPANYI TRISTATE TESTING	BENTONITE-CEMENT
INCH HOLLOW STEM AUGER M. TOTTY	SEAL OR SACK CEMENTSAND
INCH HOTARY WASH DRILLED!	II I III SEAL -
USED DURING DRILLING: O GALLONS	
PRIOR TO DRILLING: STEAM CLEAN	TOP OF CASING AT
DEVELOPMENT	SELOW GROUND LEVE
METHOD OF DEVELOPMENT FORM	71/4 INCH DIAMETER
DEVELOPMENT BEGAN DATE: TIME:	BOREHOLE C 16 tees
YIELD: TIME: DATE:	2 INCH DIAMETER
YIELDI TIME: DATE:	SCHEDULE 40 PMC BLANK CASING
GPM FROM TO .	3 to S.S feet
GPM FROM TO	6 DENTONITE-CEMENT
TOTAL WATER REMOVED	SEAL OR S-SACK CEMENT-SAND
DURING DEVELOPMENT: GALLONS	SEAL
OF TURBULTY OCLEAR OSLIGHTLY CLOUDY AT END OF	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL 0 :0 3.5 (cc)
ODOR OF WATER:	morre w. 20140
WATER DISCHARGED DROUND SURFACE TANK TRUCK	SAND PACK
TO: STORM SEWERS STORAGE TANK DRUMS OTHER	3.5 to 16 feet
DEPTH TO WATER	SLOTTED (0,010
MATERIALS USED	inch screen
	SS to ISS feet
SACKS OF MURIE CO. FILTRATISAND BOX	1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
NA SACKS OFCEMENT	BLANK SILT TRAP
MA GALLONS OF GROUT USED	BOTTOM WELL CAP
NA SACKS OF POWDERED BENTONITE	IS.5 feet
75 POUNDS OF BENTONITE PELLETS 1.5 BUCKETS	HOLE CLEANED OUT TO
FEET OF 2 INCH PVC BLANK CASING 1,5' CUTOFF	16.8 feet
10 FEET OF 2 INCH PVC SLOTTED SCREEN	BOTTOM OF BOREHOLE
YARDE CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE
YAROJ CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? WNO DYES	CALCULATED SAND=
NAME	6.25 BAGS
MELL COVER USED: DLOCKING STEEL COVER	23 51153
COTHER TE MEN AR LICLI	

		OLOLO	ore porarro poo			
JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/2/196	
SITE:	UST 702	BORING DIA.:	2-inch	ELEVATION:		
BORING NUMBER:	702-5B1	CONTRACTOR:	Parsons ET	DATUM:		
RIG TYPE:	Geoprote	WEATHER:	51. Clary, 51. breeze from north	GEOLOGIST:	D. Teets	
TEMPERATURE (°F):	~50°F	DRLG MED:	Direct Push			

• [i		Split	Laboratory		-	
	Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
'	(ft.)	file	-555	Geologic Description	Interval	Identification	Туре	ppmv	a variable for
								1,1,1,1,1	Background soil sande
	1								in biny THV1=9000m
									in Baggy THVA=90ppm 95 Hexone
. [2								
1	3				~			l	
ŀ				3-5': Clay, silty, sandy, f, bon, v. moist, no staining or odar					
l	4			no staining or odar	X			1	
,	5			,					05 +11/4 = 11/6
1				5-7 SAA except wet		1			es' THVA = 2 40 ppmv
Ì	6			DI ZIVI, ENCIPI WG					
1					$ \wedge $				
Ì	7				\angle				e7'THVA = 100ppm/
1									
	8								
	9								
ŀ	10								
	10							ľ	
	11								
li									
	12								
	13								
	4.								
	14								
1	15								
•									
	16								
•	17								
		-							
	18								
•	10								
.	19								
	20					V			
	20						l		

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

		<u> ULULU</u>	OIC DOMING EQU			
JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96	
SITE:	UST 702	BORING DIA.:	2-1hch	ELEVATION:		
BORING NUMBER:	702-5BZ (MPA-5,5	CONTRACTOR:	Parsons EJ	DATUM:		
RIG TYPE:	Gaprobe	WEATHER:		GEOLOGIST:	D. Teets	
TEMPERATURE (°F):	~ 500E	DRLG MED:	Dinect Rich			

e [Split	Laboratory	<u> </u>		
	Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
1	(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
• [Rackyround soil
	1								THYA: 90 DDM
									93 Hergne
	2						·		
•	3								
ŀ	4			3-5': Clay, silty, brn, iron oxide staining, gray, no war, moist					
	4		1	gray, no war, moist	X		Ì	V	
	5								05 THVA=160 gomv
1				57:5-6.5: SAA except per roleum oder					~ 111/17 100pm
	6			6.5-7.0: SAI except wet	$ \bigvee $				
	7			·					e7'THYA=260ppmv
									,,
	8								
-	_								
	9								
1	10								
	10								
	11								
						•			
	12								
							İ		
	13								
•									
• }	14								
1	15								
• ⊦									
·	16								
•	17								
	18								
•				·					
_	19								
1	20								
4	20		L				I		

PID - Photoionization Detector

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COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

		<u> </u>	OLC DOMINIO DOO			
JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96	
SITE:	UST 702	BORING DIA.:	2-inch	ELEVATION:		
BORING NUMBER:	70Z-5B3	CONTRACTOR:	Parsons ES	DATUM:		
RIG TYPE:	Georghe	WEATHER:		GEOLOGIST:	D. Teets	
TEMPERATURE (°F)	IN MOF	DRLG MED:	Digat Ass			

	Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
1	1								Rackground Soil THUA = 90ppmy
	3								TO CAPICE
ıE	4			3-5: Clay, silty, brn, slaray, no ador, no staining, moist (BACKFILL?)	X	. 1			P.S THVAZ YODOWN
	5			5-7': SAA except west	$\langle \ \rangle$,			Q5 THVA= 40 ppmy PD = 2.0/2.0
	7				X				e7' THVA=9000mV PID=1.8/1.8
	9								
	10								
	11								
	13				·				
	15								
	16							•	
	17								
E	19	,				$\circ d$			
L	20								

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace SS - Split Spoon Sample

BS - Brass Sleeve Sample

JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
SITE:	UST 702	BORING DIA.:	2-inch	ELEVATION:	
BORING NUMBER:	702-SB4	CONTRACTOR:	Parsons ET	DATUM:	
RIG TYPE:	George	WEATHER:		GEOLOGIST:	D. Teets
TEMPERATURE (°F):	~50°F	DRLG MED:	Dinat Rich		

				Split	Laboratory			
Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
								Background Soil
1								THVA = 90 DAMV
								45 Heagne
2								
						l		
3								
			·	[
4						Į.		
			4-6 - Clay, silty, bra/gray, y moist-wet,					
5			4-6': Clay, silty, bra /gray, v moist-wet,	$ \vee $				
6			,	<u> </u>		1		C6 THYA = 180 ponv PID = 1.8/1.8
7								PID = 1.8/1.8
8						ŀ		
l °								
9								
						•		
10		_		i l				
11					•			
12								
13								
' <u> </u>	_							
14								
15								
16					:			
10					•			
17								
18								
19								
		-			·			
20								

PID - Photoionization Detector

BH - Borehole

ft - Feet

COMMENTS:

SAA - Same As Above

Bkgrnd - Background HSA - Hollow Stem Auger bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

		SECE	OIC DOMINO DOO		
JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
SITE:	UST 702	BORING DIA.:	Z-ihch	ELEVATION:	
BORING NUMBER:	702-585 (MPB-5	CONTRACTOR:	Parsons ET	DATUM:	
RIG TYPE:	Geoproke	WEATHER:		GEOLOGIST:	D. Teets
TEMPERATURE (°F):	~50°F	DRLG MED:	Direct Rish		

Denth	Pro-	TISCS		Split	Laboratory	Sample	PID	Remarks
		0303	Geologic Description					Remarks
Depth (ft.) 1 2 3 4 5 6 7 8 9 10	Profile	USCS	Geologic Description 4.5': Clay, >ilty, tranlarry, iron oxide staining, moist, petroleum ador 5-(e: SAA wet, strong petroleum ador mone grossly contamnated at 5.5'-(a.o., Black-tar at 6'	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID	Remarks Brokyown Soil THVA = 90 ppmy 95 Herane R6 THVA = 260 ppmy PM = 222/1,8
12								
14								
15								
17								
18	-					:		
19	1							
20	<u></u>							

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

		ODOLO	OLO DOMINIO DOS		
JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
SITE:	UST 702	BORING DIA.:	2-inch	ELEVATION:	
BORING NUMBER:	702-SB6/mpc-4.5)CONTRACTOR:	Parsonits	DATUM:	
RIG TYPE:	Conorde	WEATHER:		GEOLOGIST:	D. Teets
TEMPERATURE (°F):	~50°F	DRLG MED:	Dinect Rush		
COMMENTS:					

		I		Split	Laboratory			
Depth	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	
							-	Backgrown soil
1								THVA = 90 ppmV
								as Hexane
2		l						
3								
4								
-			4.55': Clay silty, bon laray, from oxide					
5			9.5.5" Clay, Silty, minigray, from oxide					
			5.5-6': SAA except block staining, wet	$ \Lambda $				
6			strong potrolam odor					PID=19,2/118
		 	3'					PID=19.2/118
7								
8								
9								
-		1						
10								
11								
12								
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13								
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15		ŀ						
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19		1						
		1						
20								

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BH - Borehole

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ppmv - Parts per Million, Volume per Volume

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SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

JOB NUMBER.:	726876.68330	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
SITE:	UST 702	BORING DIA.:	2-inch	ELEVATION:	
BORING NUMBER:	702-587	CONTRACTOR:	Parsons Es	DATUM:	
RIG TYPE:	Georghe	WEATHER:		GEOLOGIST:	D. Teets
TEMPERATURE (°F):	~ 20°F	DRLG MED:	Direct Rush		

				Split	Laboratory			
Depth		USCS		Spoon	Sample	Sample	PID	Remarks
(ft.)	file		Geologic Description	Interval	Identification	Туре	ppmv	Background Soil
1	1							THVA = 900000
-	1							75 Hekgne
2								
3	-							
`	1							
4]				-			
5	-		4-55': Clay, silty, brn largy, iron exide	λ				
-	1		5.5-6" SAA extent wet	X				R6 THVA = 60 Mm
6	1		73 X C 7711 C 23 Ju 2 X					26'THVA=60MmV PID=1.8/1.4
7	4							
\ - '	1							
8	1							
-	-							
9	1							
10	1							
11	4							
11	1							
12	1							
13	-							
13	1							
14	1							
15	-							
13	1							
16	1		·					
17	4							
17	1						1	
18	1						<u> </u>	
10	4			}				
19	-							
20	1					<u> </u>	<u> </u>	

PID - Photoionization Detector

BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

DATE: AFCEE/Eaker AFB CLIENT: 726876.68330 JOB NUMBER.: **ELEVATION:** BORING DIA .: UST 702 DATUM: CONTRACTOR: Pirsoni ES BORING NUMBER: 702-SB8 D. Teets GEOLOGIST: WEATHER: RIG TYPE: Geoprobe Direct Push DRLG MED: TEMPERATURE (°F): ~50°F

				Split	Laboratory			
D	Pro-	USCS		Spoon	Sample	Sample	PID	Remarks
Depth		0303	Geologic Description	Interval	Identification	Type	ppmv	
(ft.)	file		Geologie Description					Rocksmand Soil
								Backgrand Soil THVA=100ppm
1						i		144-100/00
						l		
2							ļ	
							l	
3		İ				!		
<u> </u>						1		
4				i l			ĺ	
4		İ	be fall the could be followed major	1		İ		
			4-(e': clay, vsilty, bun/slgray, moist,			1	ŀ	
5			no ades	X		1	1	PGG! THVA = 100 Mmv
		1		{		1		PID= 1,0/1,0
6			,	/				710-1101110
		<u> </u>		{				
7]			{			1	
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	1						}	
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13	-			1		1		
	4			1				
14	4	ŀ		1			1 -	
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17	1			4				
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18	1]		1	1	
10	┨	1				1	1	
19	-	1						
19	4			7				
	4			1		1		
20		1						

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

COMMENTS:

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

DATE: AFCEE/Eaker AFB CLIENT: JOB NUMBER .: 726876.68330 ELEVATION: Z-inch UST 702 BORING DIA.: SITE: DATUM: CONTRACTOR: Parsons ES BORING NUMBER: 702-SB92 D. Teets GEOLOGIST: WEATHER: RIG TYPE: Geoprobe Direct Push DRLG MED:

Depth Pro- USCS Geologic Description Spoon Sample Sample Type PID Remarks									
Depth Pro- USCS Geologic Description Interval Identification Type ppmv					Split	Laboratory			
(h.) file Geologic Description Interval Identification Type ppmv Section	Depth	Pro-	USCS						Remarks
				Geologic Description	Interval	Identification	Туре	ppmv	
2 3 4 4 4 5 7 7 8 8 9 10 11 11 12 13 14 15 16 17 18	(10.)	- Inc							Background soil
2 3 4 4 4 5 7 7 8 8 9 10 11 11 12 13 14 15 16 17 18	1								THUA = 40 pans
2 3 4 4 4 5 7 7 8 8 9 10 11 11 12 13 14 15 16 17 18						1		1	95 Herone
3 4 4 4 5 6 7 8 9 10 11 11 12 13 14 15 16 16 17 18						<u> </u>			
4 4 5 10 11 12 13 14 15 16 17 18 19	2				1				
4 4 5 10 11 12 13 14 15 16 17 18 18							1		
5	3				Í				
5				·	{		1		
PD = 1.5/1/2 PD =	4				7				
PD = 1.5/1/2 PD =				4-6; Clay, v silty, Drn Isl gray, moist,	{\/				OG! THVA= FURAN
6 7 7 8 9 9 10 11 11 12 13 15 16 16 17 17 18 18 19 19	5		İ	no odo	ł X	1	1		AD=1,5/1,2
7 8 9 10 11 11 12 13 14 15 16 17 18 19					/ \				1100
7 8 9 10 11 12 13 14 14 15 16 17 18	6	}		,			,		
7 8 9 10 11 12 13 14 14 15 16 17 18		1	i		1	5			
8 9 10 11 11 12 13 14 15 16 17 18 18	7				X	FIRST	1		
9]	1		Z		1		
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14 15 16 17 18 19		1	i		4				
14 15 16 17 18 19	13	1			4				
15		1	İ		4				
16 17 18 19	14	1			4				
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17 18 19		1			4	1	1		
17 18 19	16	1			4]		
18		1			1				
18	17	1			4				
19		1							
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	-	1			1				
	19	1			4		1		
		1			1			1	
20	20	1						1	1

PID - Photoionization Detector

BH - Borehole

TEMPERATURE (°F): COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

PARSONS ENGINEERING SCIENCE, INC.

G - Grab Sample

OB NUMBER.:	726876.68330		AFCEE/Eaker AFE	1		DATE:		3/21/96		
ITE:	UST 702	BORING DIA.:	Z-inch			ELEVAT				
ORING NUMBER:	702-5B10	CONTRACTOR:	Parsons E			DATUM				
IG TYPE:): uso F	WEATHER:				_GEOLOG	ist:	D. Teets		
EMPERATURE (°F): <u>~50°F</u>	DRLG MED:	Direct Push			-				
OMMENTS:						-				
		-		Split	Laboratory	T				
Depth Pro- US	CS			Spoon	Sample	Sample	PID	Remarks		
(ft.) file		Geologic Description		Interval	Identification	Туре	ppmv			
1										
2						1				
3										
4				()	Na					
	Clayersi	lty, brn/slgvay, n	noist, no		No Samples					
5	oder			Х	Samples			260 +4447 140		
6					•	1		PID=15/1		
7										
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19						1				
19										
20						1				
						G - Grab	Samola			
PID - Photoionization	on Detector	bgs - Below Ground S	Surface			G - Grac	Sample			
BH - Borehole	s Above ground	na - Not Analyzed ppmv - Parts per Mill	ion. Volume ner Vo	lume						
SAA - Same As Ab Bkgrnd - Backgrour		HS - Sample Headspa								
HSA - Hollow Stem		SS - Split Spoon Samp								
ft - Feet		BS - Brass Sleeve Sar								

			20000			
	JOB NUMBER.:	726876.68230	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
ļ		Building 457 Area	BORING DIA.:	Z-inch	ELEVATION:	
	BORING NUMBER:	702-5B11	CONTRACTOR:	Parson 1 KS	DATUM:	
ì	RIG TYPE:	Georghe	WEATHER:		GEOLOGIST:	D. Teets
ı	TEMPERATURE (°F):	TO SE	DRLG MED:	Dines L Purh		

Depth	Pro-	uscs		Split Spoon	Laboratory Sample	Sample	PID	Remarks
(ft.)	file	COCD	Geologic Description	Interval	Identification	Туре	ppmv	
(11.)	1110							
1								
						!		
2		i						
3								
4								
5				X				
				//				06 +HUA= 50
6				7				e6'THVA=50 PID=1.2/1.2
7								e8'THVA=60 PID=1.2/1,72
								PID = 1.2/1,2
8				-				
			31 15710 1 1 1 0	•		}		
9			Mo visible contamination e	ĺ				
10			30.					
11								
10							Ì	
12				1			ł	
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17								
18								
10	1]				
19	İ			1				
]			1				
20					1	<u> </u>	<u> </u>	

PID -	Photoionization	Detector
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BH - Borehole

COMMENTS:

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

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HS - Sample Headspace

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PARSONS ENGINEERING SCIENCE, INC.

G - Grab Sample

					. /
JOB NUMBER.:	726876.68230	CLIENT:	AFCEE/Eaker AFB	DATE:	3/21/96
	Building 457 Area	BORING DIA.:	2-inch	ELEVATION:	
BORING NUMBER:	702-SB12	CONTRACTOR:	Parsons Es	DATUM:	
RIG TYPE:	-	WEATHER:		GEOLOGIST:	D. Teets
TO THE ATTIME (°E).	Geoprahe	DRIG MED:	Dher L Arel		

Depth Pro- USCS Geologic Description Syoon Sample Sample Type PID Remarks	-					Split	Laboratory			
Check Cologie Description Interval Identification Type ppmv		D45	P=0	TIECE				Sample	PID	Remarks
1 2 2 3 4 4 4 5 5 5 6 6 7 7 8 8 8 9 9 10 11 11 12 13 13 14 14 15 15 16 16 17 18 18 19 19	ı			USCS	Geologic Description					
2 3 4 4 5 5 6 6 7 7 7 7 7 7 7 7	P	(11.)	ПС							
2 3 4 4 5 5 6 6 7 7 7 7 7 7 7 7	Bŀ	1								
3 4 5 6 7 8 9 10 11 11 12 13 14 15 16 16 17 18	ŀ									
4 4 4 5 6 Cockfill, Sand 6 7 7 8 8 9 10 11 11 12 12 13 13 14 15 15 16 16 17 18 18 19 19	P	2								
4 4 4 5 6 Cockfill, Sand 6 7 7 8 8 9 10 11 11 12 12 13 13 14 15 15 16 16 17 18 18 19 19							,			
4		3							ļ	
S							·			
S		4			1:10 1.0:11 6. /	F /				
6 Pip: 1.2/1.2	-	-			4-6 1Sack+11, 392					
7 8 8 9 10 11 11 12 13 14 14 15 16 16 17 17 18	B					ΙX				06'THVA=50ppm
7 8 9 10 11 12 13 14 15 16 16 17 18		6								PID=1,Z/1,Z
8 9 10 11 11 12 13 14 15 16 17 18						ľ				
9 10 11 11 12 13 14 15 16 17 18 19		7				Į				
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Bkgrnd - Background

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ft - Feet

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ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

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BS - Brass Sleeve Sample

G - Grab Sample

Halliburton NUS

FIELD LOG OF BORING

WELL NO. TWIGO

CORPORATION

PRO.	ECT:			EAK	CER A	AFB I	RFI		JOB	NO.:	01	14	BORING/WELL N	0.: Tw	160)]
	(u	57	ص	AD	(لەه				LOG	GED I	BY: B.	MCCANLESS	TOTAL DEPTH O	F BOREHO	LE: 1	(c '
DRIL	LING (CONT	RACT	OR:		Tri-S	State	Testi	าตู			SURFACE ELEV.:		DATUM:		
DRIL	LER'S	NAM	E: 🔾	TOE	FL	EE	GE	R				START TIME: 094	o	DATE:	9/12	195
DRIL	L RIG	TYPE	: C	.m	E 5	5						FINISH TIME: 1017	7	DATE:	1/12	195
BORI	NG M	ETHO	D: 7	114	" F	ISA						WATER DEPTH:				
		METER										DATE:				
		MET				e A	RRE	LL	コナレ	u 1 cc € R	7	TIME:				
		WGT.					1	P HGT				BACKFILLED, TIME:		DATE:		
		COND					TA	750	Ν			WEATHER: CLEA	R. BREEZ	E 70	315	
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	ГІТНОГОСУ		TCH OF BORING		√ ₁	THE STATE OF THE S
													MATERIAL DESCR	RIPTION		
	SB W/ Iiner	WA	5'	3.5"	100/	DRy	57F				y	0.5-5' 5	ANO-5;	1+y 5	ANI	0
	liner			Ц	100		1	5/4				FILL, pec	gravel +	1.5	1 11	ellowish
					80	ا الانتا	NPT.					brown san				
					/30											
					90%											
					400					Í						
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ε			2'	1.5'	1 /		$ \ $	10yR			.5P	8-16 SA	N'D 50	me si	1+	ruot lets
					120			116			i	8-16 SA charcoal pi	eces th	couch	00t	
					20/	IT	$ \top $					angulan to s				
10		$ \ /\ $			100							FUEL COOK				
								<u></u>								

NOTES: DETERMINE PRESENCE OR ABSENCE EDITED BY/DATE:

OF CONTAMINATION & YOU PPM AT 3' WAS 10 PPM LIPILTER



FIELD LOG OF BORING

WELL NO. TW 1601

16	*/ <u> </u>	COF	RPOF	RATIO	<u> </u>							
PRO	JECT:		EAI	CER A	FB R	FI				JOE	3 NO.:	0114 BORING NO .: Tw/601
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	•	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	итн.	
10	SB	MA	5'	1.51	50	SAT	loose				SP	SAND as from 8' 9+2 Nihert ansular to subrounded 2"DIA. CHARCOAL AT 11'
	-	+	H	H	760		1	-	_		A	2"OTA CHARCOAL AT IL
												and the state of t
	+	\vdash	\vdash	-		-	-				H	
	1		$ \ $								Н	
			П									
15	+	-	1'		1.0						2	much charcial 15-15.5'
16			١,	1	اورا							
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NOTES:______ EDITED BY/DATE:____

FIELD WELL COMPLETION FORM	•	CHRISTY BOX
NAME: EAKER AFB		LOCKING STEEL COVE
10.5	JENKINS	TINCH DIAMETER STEEL CONDUCTOR CASING
LOGGED BIMC (ANLESS EDITED		tofeet
NAME: TWIEDI	DATE: 9/12/95	BOREHOLE
COMPANY TRI-STATE		to feet
EQUIPMENT: T 7/4 INCH HOLLOW STEM AUGER	J. FLEE GER	BENTONITE CEMENT
INCH ROTARY WASH	DRILLED: 0.75	BSACK CEMENT SAND
USED DURING DRILLING: 10 13	GALLONS	tofeet
PRIOR TO DRILLING: STEAM CL	FAN	TOP OF CASING AT
DEVELOPMENT		FEET ABOVE AT BELOW GROUND LEVE
METHOD OF SEE DEVELOPMEN	ut form	BOREHOLE
DEVELOPMENT BEGAN DATE: TIME: YIELD: TIME:		C to 1 lo leet
GPM FROM TO	DATE	2 INCH DIAMETER SCHEDULE 40 PVC
GPM FROM TO	DATE:	BLANK CASING
GPM FROM TO	DATE:	FU TO CO Teet
GPM FROM TO	DATE:	SEAL OR SEAL OR SEAL OR
	GALLONS	SEAL
OF TURBIDITY CLEAR SLIP	GHTLY CLOUDY	BENTONITE PELLET
ODOROF	RY MUDDY	SEAL O 10 4 feet
WATER: WATER DISCHARGED GROUND SURFACE TANK TO	BUCK	morse co 20140
TO: STORM SEWERS STORAG		SAND PACK Y 10 16 feet
DEPTH TO WATER	•	2 INCH DIAMETER
MATERIALS USED	EET	SLOTTED (C.O.O.
The state of the s	Och	C to 16 feet
41/3 SACKS OF MURTE CO. FILTE	LATIONSAND	SCHEDULE 40 PVC BLANK SXT TRAP
SACKS OF GALLONS OF GROUT USED	CEMENT	ELANK ST. I HAP
SACKS OF POWDERED RENTOWER		BOTTOM WELL CAP
POUNDS OF BENTONITE PELLETS	Ruchen	16 leet
FEET OF INCH PVC BLANK CASING		HOLE CLEANED OUT TO
10 FEET OF 2 INCH PVC SLOTTED SCREEN	ı	BOTTOM OF BOREHOLE
1		16 leet
YARD ³ CEMENT-SAND (REDI-MIX) ORDERE YARD ³ CEMENT-SAND (REDI-MIX) USED	ED .	NOT TO SCALE
CONCRETE PUMPER USED? ONO OYES		ADDITIONAL INFORMATION:
NAME AND DAES		SANO CALC: 6BAGS
WELL COVER USED: LOCKING STEEL COVER		
DCHRISTY BOX DOTHER TEMP LOELL		

	CHAIN	5	Š	0	CURTODITA	E	ECONID PRINCIPALITY CA	É	A	Ĕ	Į	SEF	RESERVED EN		O H	TST		1	ĺ		
						Evergreen Analytical Inc.	reer	An	alvti	call	nc.						í		P.	Page Lof	7
COMPANY PARSON ES				•		. <<		4036 Youngfield St. Wheat Ridge, Colorado 80033	oungfie Ridae.	ld St. Colora	30 800;	83	O	LIENT	CONT	CT (pri		AVE	CLIENT CONTACT (print) NAVE TEETS		
& Z	7	300				(((303) 425-6021 FAX (303) 425-6854	25-602	1-6854			а. ш	PROJECT I.D. EAL. QUOTE #	PROJECT I.D EAL. QUOTE #	1976	240	746576.68150	P.O.#		
PHONE# (303)831-8/00	3	# **	303) धरा	FAX# (305)831-8208	_		(800) 8 FAX F	300) 845-7400 FAX RESULTS	us (Y)	z >		-	URNA	JUOPE	TURNAROUND REQUIRED*		M STD	·	STD UST (3 day)	(3 day)
Sampler Name:)			•	expedit	pd truck	rounds	ubiect	Other (Speci	☐ Other (Specify)_ o additional fee		
(signature)			MATRIX	X.					AN	ANALYSIS		EQU	REQUESTED		برمار-				EAL	EAL use only Do not write	# 1 47 1 47 1
การ een Analytical Cooler No	PES-1	1 50.10	ouno		slatel			(ejo)			(circle)		948WS	shur.					inst	in shaded area	-
Nada secolda	L	3,7/0320qo	เฮ/ลโมะแว		West/Herb/N	(9)5.	(-lozio) 80	15 (circle)		-,, 0359]	Gasoline		- DM / 2M	7					EAL		
all information:	on:		sıcı/bus		I/AN8/	052 (cil	9/0808	9/0010	u	D & IIO/	DOM:	powg	l metal Netals I metan 1	1/2/1/2	_	_			Project # Custodian_		
CLIENT SAMPLE	DATE	Vo. of Cont	Mater-Drink (circle) Soil \ Solid	egbul& \ iiC	TCLP VOA (circle) VOA 82601	0528 AOV	resticides	Pest/PCBs Herbicides	99,300	BTEX 8020, TAPH 418.1,		LOO LI 17.	Total Metal (circle & lis Dissolved (circle & lis (circle & lis	אי אוגיוי				Alian Park	EALS	Sample No.	
	-	-				+			1-	+-	+	 		-					14 C. L. S. L.		
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6.5-8		-	X					9			188			X						2	
11-10-11		-	X					50	% >							-					
20			X					3/5		-				$\overline{\mathbf{x}}$							
- MPC- 10-11	,	1	χ.						*		Z!	_		-		-					
\	3/20196 1115		\succeq						\preceq		X	\dashv		\dashv				-			
551-MPB-19-20 3	5/20/96 1130	-	\times				-				X.	\dashv		-			1				
01-6-	3/70/96 1550		7						7	1	Z	_						25 ·			
																		٥	ocation		
DD:														\dashv				8	Container S	Size	
Instructions: For B	BTEX + TPH		ploase	29,	Sample	Ton	}	7	"Ce	1/20	Coppe		Pno	1	210 Penen	on Liall	3				
Please	FAX	oreliminary		1650	45	ASAP					:										
														4	ŀ	_	1	Contraction () and Positioned	low		Oato/Time
9	Date/Time Received by: (Signature)	Received 1	oy: (Sig	nature)			Date/11	Date/Time Relinquished by: (<i>Signature)</i>	inquist	ed by:	(Signa	ıture,		š	Date/IIme		Ned by	יזיינייט)	ne)	<u>.</u>	2
Davel act	24/52/5	757	なった	ر.																	

TURNAROUND REQUIRED* 10 STD (2 wks) 🗖 STD UST (3 day) in shaded area EAL Sample No. Page 2 of EAL use only Do not write Container Size CLIENT CONTACT (print) DAVID TERETS Custodian Other (Specify) Project # *expedited turnaround subject to additional fee Location P.O.# 726876,68130 CHAIN OF CUSTODY RECORD FRANKINCAL SERVICES FREQUEST PROJECT I.D. EAL. QUOTE # Total Metals-DW / NPDES / SW8 (circle & list metals below)

Dissolved Metals - DW / SW846

(circle & list metals below)

PM, Alk (List below)

PM, Alk (List below) ANALYSIS REQUESTED TEPH 8015mod. (Diesel) Wheat Ridge, Colorado 80033 (Gasoline) (Gasoline) FAX RESULTS (Y) / N Evergreen Analytical Inc. TRPH 418.1/Oil & Grease 413.1 (circle) \times (303) 425-6021 FAX (303) 425-6854 (800) 845-7400 4036 Youngfield St. BTEX 8020/602 (circle)/MTBE (circle) PCB Screen Herbicides 8150/515 (circle) Pest/PCBs 8080/608/508 (circle) Pesticides 808/608 (circle) BNA 8270/625 (circle) \ll VOA 8260/624/524.2 (circle) FAX # (503) 83/-8203 TCLP VOA/BNA/Pest/Herb/Metals egbul2 / IiO MATRIX bilo2 / lio2 Water-Drinking/Discharge/Ground 05208 alz No. of Containers 542 900 1340 22 TIME 1340 1630 1030 1315 1230 7/21/96 1000 020/ 7122/96 SAMPLED 3/22/96 551-VW4-10-165 3/22/96 3/11/26 96/12/2 3/11/2 Pursons Evergreen Analytical Cooler No. DES-1 26/12/5 3/21/5/0 DATE Please PRIN STATE (O ADDRESS 1700 Brogalings all information: YAVID TECTS COMPANY Parsons 63 PHONE# (303) 831-800 551-VW5-9.5-10.5 302-MPC-5,5-6 702-MPB-5.5-6 01-6-8M1 -155 701-MPA-6,5-7 IDENTIFICATION 9-2'5-MM-20F 702-MPA-4-5 2 302- MPC- 4-5 SAMPLE CLIENT Sampler Name: CITY DONUE Cooler Received Instructions: (signature)__ (print)_ 00 Ϊ

Date/Time Received by: (Signature) 3/25/96 Relinquished by: (Signature)

Frence

Page Lof. SERVICES REQUEST

CUSTOUT RECORD/ANALT HOAL SE	Evergreen Analytical Inc.
CHAIN OF COS	

FAX# (503) 831-820@

06208 diz

STATE (C)

CITY DONA

PHONE# (303)871-8/00

CHE 900

ADDRESS 1700 Brownluen

COMPANY PARSONS 23

4036 Youngfield St. Wheat Ridge, Colorado 80033 (303) 425-6021 FAX (303) 425-6854 (800) 845-7400

CLIENT CONTACT (print) DAYIN TEETS 726876,68230 F.O.# PROJECT I.D.

STD UST (3 day) TURNAROUND REQUIRED*()X(STD (2 wks) EAL. QUOTE #_

z

FAX RESULTS

Other (Specify).

'expedited turnaround subject to additional fee

ANALYSIS REQUESTED 🍕

Do not write in shaded area

EAL use only

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Name:
ampler N

MATRIX

DAVID LIBER Evergreen Analytical Cooler No. Cooler Received

EAL Sample No.			
			-
SSEND OS SAFERONO NAT	7		×
Circle & list metals below) Dissolved Metals - DW / SW846 Circle & list metals below) Place of the first metals below)		<u>~</u>	
Total Morting (Diesel)			_
Casoline)	-		_
A Grease A12			
BTEX 8020/602 (circle)/MTBE (circle)			
PCB Screen			
Pest/PCBs 8080/608/508 (circle) Herbicides 8150/515 (circle)			L
Pesticides 8080/608 (circle)	_	_	L
(circle)	_	_	_
ON 0260/624/524.2 (circle)	-	-	
TCLP VOA/BNA/Pest/Herb/Metals (circle)			
egbul2 \ IiO	_	_	L
(circle) Soil \ Solid		-	-
Water-Drinking/Discharge/Ground	\vdash	=	╞
No. of Containers	-	-	Ĺ
TIME	12.5		
PRINT nformation: DATE DATE	16/3/1	4/2/26	1
Evergreen Analytical Cooler No Cooler Received PRIN Please PRIN all information: CLIENT SAMPLE D, IDENTIFICATION SAM	17-7-NOR-5-10	US 3-MOR-6-7	

005/96/5/12

Instructions: 90

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Relinquished by: (Signature)

Day I Lest

Date/Time Received by: (Signature)

Date/Time Relinquished by: (Signature)

Date/Time | Received by: (Signature)

Date/Time

Container Size

Location



AIR TOXICS LTD. AN ENVIRONMENTAL ANALYTICAL LABORATORY

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA 95630-4719 (916) 985-1000 FAX: (916) 985-1020

CHAIN-OF-CUSTODY RECORD Nº

noce34
Page 1 of 2

Company RAR SWAS Address 1700 Broans And States Address 1700 Broans And States Phone (202) 834-8100 Collected By: Signature And And States Lab Field Sample HS7-MPB-S SS1-MPB-9 SS1-MPB-8 SS1-MPR-9 SS	Project info: Pr	Date &	5-5 425/96 1325/04 TO-3(as diesel)	325960	1 26/22/5		1530 JELIS		-8.5 3/27/40 1552 ·	06/6/15	96/14/15	1430	Received By: (Signature) Date/Time	me Received By: (Signature) Date/Time	Air Bill # Opened By: Date/Time Temp. (°C) Condition Custody Seals Intact? Work Order #	,	
	SUMS ETS WAY SHE POO OO	Field Sample I.D.	457- MPB-5 3/25			P13-9		6.	5			1430		Date/Time		,	

Water Control of the Party of t



AIR TOXICS'LTD. AN ENVIRONMENTAL ANALYTICAL LABORATORY

OXICS'LTD. TALANALYTICAL LABORATORY CHAIN-OF-CUSTODY RECORD Page 2 of 2	Project info: Project info	
AIR TOXICS'LTD. AN ENVIRONMENTAL ANALYTICAL LABORATORY CHAIN-C	Contact Person DAVID TEETS Company PACSONS ES Address 1700 Broadway Ste 108 (303) 83/-8100 Phone (303) 83/-8100 FAX (303) 831- Collected By: Signature	

Lab			
5(VWΦ) Ψ/Ψ/Γ/Γ 1020 TO-3 (45 jet 10.00) 9,5 Ψ/Ψ/Γ/Γ 1315 Ψ 5 Ψ/Ψ/Γ/Γ 1315 Ψ 5 Ψ/Ψ/Γ 1525 TO-3 (45 Diezellang		Canister Pressure / Vacuum	Vacuum
5 (νω6) Ψ/Ψ/Γι 1020 ΤΟ-3 (95 jet 10.00) 9,5 Ψ/Ψ/Γι 1315 Δ 5 Ψ/1/96 1525 ΤΟ-3 (95 Diese! 5 Ψ/1/96 1525 ΤΟ-3 (95 Diese! 4/1/96 1525 ΤΟ-3 (95 Diese! 4/1/96 1525 ΤΟ-3 (95 Diese! 4/1/96 1525 ΤΟ-3 (95 Diese! 4/1/96 1525 ΤΟ-4 Το-4 Το-4 Το-4 Το-4 Το-4 Το-4 Το-4 Το		Initial	Receipt
9,5 41μβC 1315 ± ΣΟ-3 (9.5 Diezel strine Print Name Print Name Heceived By: (Signature) Date/Time Heceived By: (Signature) Date/Time Heceived By: (Signature) Date/Time Temp. (*C)			
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					Elapsed	i									
	Days Elapsed		Hrs elapsed (fractional	Days Elapsed	min. x	Flapsed				Helium		Trend of O2/	New	k	k (%,/hour)
Date	(frac. days)	Time	days)	000	1000)	(hours)	02%			_	Comments	20 1963849	x-values	0.017974	
03/29/96	0.00	09:28	0.00	0.00	0.00	0.00	10.0	10.00	28	, t	o sec. puige.	10 4902543	0.54		
96/6	0.00	08:0	0.02	1		0.40	5 6	2 2	3	100					
96/6	0.00	11:10	0.07	0.07		0.7	5.0	70.0	000	100					
03/29/96	0.00	12:24	0.12			2.93	18.0	0.08	180		2 0000				
03/29/96	00.0	14:40	0.22			5.20	14.5	0.10	400		Confirmed O2/CO2 calibration.				
29/96	0.00	18:25	0.37	0.37		8.95	10.3	0.15	980	5.6					
03/30/96	1.00	08:25	-0.04		1.38	22.95	3.8	0.50	5,200	3.9	30 sec. purge.				
03/29/96	0.00	09:26	0.00	00.00	0.00	0.00	20.0	0.05	140	_	30 sec. purge.	19.793609	0	0.018384	1.103011
96/66/8	0.00	09:55			0.03	0.48	19.3	0.07	220	6.1		9.86650645	0.54		
3/29/96		11:05		0.07		1.65	17.9	0.07	570	5.1					
3/20/06		12.22		1		2.93	16.3	0.08	730	5.8					
03/29/96		0.00 14:40	0.22			5.23	14.0	60.0	1,000	6.1	Confirmed O2/CO2 calibration.				
3/56/86		18:30				9.07	9.6	0.11	1,300	6.3					
3/30/86		08:30		96.0	1.38	23.07	4.8	60.0	3,000	5.6	30 sec. purge.				
03/29/96	0.00	09:24	00.00	0.00		00.00	19.5	0.10	3,000		30 sec. purge.	20.222457	0		0.020787 1.247216
3/29/96	0.00	09:53		0.02		0.48	19.5	0.10	94	6.1		9.20538289	0.53		
03/29/96	0.00	11:00					18.7	0.08	200	5.7					
03/29/96	00.00	12:14					17.2	0.10	440	5.9					
03/29/96		14:35				1	14.0	0.20	1,800	_	Confirmed O2/CO2 calibration.				
36/66/6		18:15			l		8.8	0.30	7,800	5.1					
03/30/96	1 00	08:30	-0.04	0.96	1.39	~	1.6	1.50	5,200	3.5	30 sec. purge.				
						l									
90/06/60		00.00	000	000	00 0	00 0	20.8	0.05	96	NS		21.0030469	0	0.018512	1.110705
00/00/00		00.40					20.6	0.07	250	NS		11.1918175	0.53		
3/20/0/		11.00	0.07				19.2	0.07	350	NS					
03/29/96		0.00 12:10			0.17		18.0	0.10	200	SN					
3/29/9		14:30					15.5	0.10	700		Confirmed O2/CO2 calibration.				
3/29/9		18:10	0.37	0.37			11.0	0.20	1,200	NS					
96/08/80		08:40			1.40	23.33	2.4	0.50	4,000	NS	30 sec. purge.				
														- 1	
03/29/96		09:15	00.00				20.7	0.10	320		2 min. purge.	20.7947117	0		0.016140 0.968413
3/29/9		09:45		0.02			20.1	0.10	670	SN		11.9175879	0.55		
03/29/96		11:15		0.08			19.3	0.10	1,250	NS					
3/29/9		12:20		0.13			18.0	0.10	1,300						
03/29/96		0.00 14:35				5.33	15.2	0.12	1,700		Confirmed O2/CO2 calibration.				
03/29/96		18:20	0.38				12.1	0.25	2,400	NS					
9/38/90	4 00	26.90		١	0, 1	0000	3								_

4/18/96

4/16/96

Initial Respiration Test BLDG 457 Eaker AFB, AR

					-				-			_	_		
						Elapsed	Flancad			Total					-
Monitoring	Date	Days Elapsed (frac. days)	Time	(fractional days)	Elapsed	(min. x 1000)	Time (hours)	02%	CO2 6	Hydro- carbon	Comments	Trend of O2/ Time	New x-values	k (%/minute)	k (%/hour)
MPR.5	03/27/96			0.00	0.00	00.00	0.00	20.8	0.10	90 3	30 sec. purge.	20.8878		0.052120	3.127200
MPR-5	03/27/96					0.03	0.50	19.5	0.10	38 3	30 sec. purge.	13.0698	0.15		
MPR-5	03/27/96	00.00	09:10			90.0	1.00	17.8	0.10	50 3	30 sec. purge.				
MPR-5	03/27/96	0.00	09:40			0.09	1.50	16.0	0.10	64 3	30 sec. purge.				
MPR-5	03/27/96	0.00	10:35			0.15	2.42	13.4	0.10	80 3	30 sec. purge.				
	90120700	0	40.4		0 17	0.25	4 08	10.5	0 10	54	30 sec. purge, low battery HC				
0-016	03/2/130		74.40			96	9		5	100	Recalibrated O2/CO2 meter at				
MPB-5	03/27/96	0.00	18:40				-	1 .	0.20	160	160 30 sec. purge, dilution value HC.				
20	200		1000					1 L	0.07	401	40 30 soc mirae	20 1594595	0	0.057568	3.454054
MPC-4.5	03/27/96		cu:80 00.0			0.00		200		200	20 20 20 20 20 20 20 20 20 20 20 20 20 2	11 5243243	6		
MPC-4.5	03/27/96		08:35		0.02	0.03	0.30	- 1	1	300	30 sec. purge.	2017011			
MPC-4.5	03/17/06		0.00	0.0						42	30 sec. purde.				
MPC-4.3	03/27/90		0.00						0.08	54	30 sec. purge.				
MIT C-4.3	03/21/30		3								30 sec. purge, low battery HC				
MPC-4.5	03/27/96	00.00	12:15	0.17	0.17	0.25	4.17	6.3	0.10	30	meter.				
MPC-4.5	03/27/96	0.00	14:05	0.25	0.25	0.36	9.00	7.0	0.08	67	Recalibrated OZ/COZ meter at 1350. AC hookup on HC meter.				
MPC-4.5	03/27/96		18:35		0.44	0.63	10.50	0.0	0.50	300	300 Used dilution value on HC meter.				
			30		1	L	000	9 00	0 4 0	30	20 2 min minos	19 8428904	0	0.043170	0.043170 2.590210
VW1	03/27/96		0.00 08:20	0.00	0.00	0.00		-	-	200	2 min purge.	13 367366	0		
W1	03/27/96		08:45				1 00			38	34 2 min. purge	200.00			
LW.	03/27/96	0.00	09.20						1	44	2 min. purge.				
	03/27/96		10:45					14.1	0.10	56	2 min. purge.				
, VW1	03/27/96				0.17	0.25	4.08	13.3	0.12	10	2 min. purge. Low battery HC meter.				
VW1	03/27/96									44	2 min. purge.				
VW1	03/27/96	0.00	18:55	5 0.44	0.44	0.64	10.58	10.0	0.50	44	2 min. purge.				
	20,50		100.45		000	00 0	00 0	20.5	0.10	38	38[30 sec. purge.	19.3742	0	L	0.050680 3.040800
MPA-5.5	03/21/90		0.00 00.13	0.00				1	١.	35	35 30 sec. purge.	11.7722	0.15		
MFA-5.5	03/27/90		00.1					1	1_	42	42 30 sec. purge.				
MPA-5.5	03/22/98		09:45				l		L.	44	30 sec. purge.				
MPA-5.5	03/27/96	0.00	0 10:40						0.10	53					
	20100		10.00				4 08		0 12	17	30 sec. purge, low battery HC				
MPA-5.5	03/2//30		7 7				1	1		45	Recalibrated O2/CO2 meter at				
MPA-5.5	03/27/96		0 14:15				0.00	- (1	SIN	45 1950. ACTIONAL CHARGE				
MPA-5.5	03/27/96		0.00 18:50	0.44	4 U.44	0.04		1	_]	2	or sec. purge.				

Initial Respiration Test UST 702 Eaker AFB, AR

ioring Elapsed (frac. days) Time days) Elapsed (frac. days) Time days) 04/03/96 0.00 09:07 04/03/96 0.00 10:15 04/03/96 0.00 09:27 04/03/96 0.00 09:25 04/03/96 0.00 09:55 04/03/96 0.00 12:23 04/03/96 0.00 15:05 04/03/96 0.00 15:05 04/03/96 0.00 15:05 04/03/96 0.00 15:05 04/03/96 0.00 15:05							Elapsed									
Point Date Historian H			Days		Hrs elapsed	Days	Time	Elapsed			Total Hvdro-		Trend of 02/	New	~	~
04/03/96 0.00 09:07 0.00	Monitoring	Date	(frac. davs)		days)	Docate I	1000)	(hours)		C02%	carbon	Comments	Time	x-values	(%/minute)	(%/hour)
O4/03/96 O.00 O9:27 O.01 O.02 O.02 O.03 O.4 Zo.0 A.0		04/03/08		_		0.00		0.0	ı	l	300	2 min. purge.	20.4810872	0		0.665912
04/03/96 0.00 09:33 0.02 0.02 0.03 0.04 4.0 4.8 Anitar object. 64/03/96 0.00 10:15 0.05 0.07 1.1 19:8 4.8 NS after 90 sec. 5.5 04/03/96 0.00 10:15 0.00	200	2010010		200					1	1	2	Monitored purge, water pulled	19 7041903	0.07		
3-5 3-4/03/96 0.00 10:15 0.05 0.05 0.05 0.07 1.1 19.8 4.8 NS After 90 sec. Monitored purge, water pulled 19.1759119	*	04/03/96		09:33		0.02		0.4	- 1	1	2	alter ou sec.	200			
3-5 04/03/96 0.00 0.9:10 0.00	, ,	90,00,00		5.0		c		1			S	Monitored purge, water pulled after 90 sec.				
04/03/96 0.00 09:17 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.01 0.01 0.02 0.3 19.4 2.0 720 30 sec. purge, some water pulled. 15.774557 0.3 04/03/96 0.00 09:27 0.01 0.01 0.02 0.3 19.0 1.8 560 30 sec. purge, some water pulled. 15.774557 0.3 04/03/96 0.00 09:25 0.03 0.03 0.05 0.8 18.9 1.9 720 0.00 0.00 15.7745557 0.3 04/03/96 0.00 10:55 0.07 0.07 0.11 1.8 17.2 2.0 670 20 sec. purge, no water pulled. 1.00	A	04/03/30		2												
04/03/96 0.00 09:27 0.01 0.01 0.02 0.3 19.4 1.8 560 30 sec. purge, some water pulled. 15.7745557 0.3 04/03/96 0.00 09:55 0.03 0.03 0.05 0.8 18.9 1.9 720 0.00 sec. purge, no water pulled. 15.7745557 0.3 04/03/96 0.00 09:55 0.03 0.03 0.05 0.1 1.8 17.8 2.0 630 20 sec. purge, no water pulled. 15.7745557 0.3 04/03/96 0.00 10:56 0.07 0.07 0.11 1.8 17.2 2.0 670 20 sec. purge, no water pulled. 04/03/96 0.00 15:05 0.25 0.26 0.36 5.9 15.0 2.3 1,200 20 sec. purge, no water pulled. 04/03/96 0.00 15:05 0.41 0.41 0.60 9.9 15.5 2.2 1,000 water pulled. 04/04/96 1.00 08:10 -0.04 0.96 1.38				200		ľ		0	1	L		30 sec purge some water pulled	19.1759119	0	0.009448	0.566893
04/03/96 0.00 09:27 0.01 0.01 0.02 0.3 19.0 1.8 560 30 sec. purge, some water pulled. 15.7745557 04/03/96 0.00 09:25 0.03 0.05 0.05 0.08 18.9 1.9 720 04/03/96 0.00 10:55 0.07 0.11 1.8 17.8 2.0 670 20 sec. purge, no water pulled. 04/03/96 0.00 15:05 0.25 0.25 0.36 5.9 16.0 2.3 1,200 20 sec. purge, no water pulled. 04/03/96 0.00 15:05 0.25 0.25 0.36 5.9 16.0 2.3 1,200 20 sec. purge, no water pulled. 04/03/96 0.00 15:05 0.41 0.41 0.60 9.9 15.5 2.2 1,000 water. 04/04/96 1.00 08:10 -0.04 0.96 1.38 23.0 1,700 20 sec. purge, no water pulled. 04/04/96 1.00 08:10 -0.41 <	MPB-5	04/03/96		03:10				2	1							
04/03/96 0.00 09:55 0.03 0.03 0.05 0.05 0.09 1:9	A PDB 5	04/03/96		76:57		0.01						30 sec. purge, some water pulled.	15.7745557	0.36		
04/03/96 0.00 10:55 0.07 0.07 0.07 0.11 1.8 17.8 2.0 04/03/96 0.00 12:23 0.13 0.13 0.19 3.2 17.2 2.0 04/03/96 0.00 15:05 0.25 0.25 0.36 5.9 16.0 2.3 1 04/03/96 0.00 19:05 0.41 0.41 0.41 0.60 9.9 15.5 2.2 1 04/04/96 1.00 08:10 -0.04 0.96 1.38 23.0 13.7 3.0 1 04/04/96 1.00 19:10 08:10 0.42 1.42 2.04 34.0 12.8 3.3 1 1	A down	04/03/96		09.55		0		0.8	١							
04/03/96 0.00 12:23 0.13 0.13 0.19 3.2 17.2 2.0 04/03/96 0.00 15:05 0.25 0.25 0.36 5.9 16.0 2.3 1 04/03/96 0.00 19:05 0.41 0.41 0.60 9.9 15.5 2.2 1 04/04/96 1.00 08:10 -0.04 0.96 1.38 23.0 13.7 3.0 1 04/04/96 1.00 19:10 0.42 1.42 2.04 34.0 12.8 3.3 1	MPR.5	04/03/96		10:55				1.8	l			20 sec. purge, no water pulled.				
04/03/96 0.00 15:05 0.25 0.25 0.25 0.25 0.25 0.36 5.9 16.0 2.3 1 04/03/96 0.00 19:05 0.41 0.41 0.60 9.9 15.5 2.2 1 04/04/96 1.00 08:10 -0.04 0.96 1.38 23.0 13.7 3.0 1 04/04/96 1.00 19:10 0.42 1.42 2.04 34.0 12.8 3.3 1	MPB.F	04/03/96		12:23								20 sec. purge, no water pulled.				
04/03/96 0.00 19:05 0.41 0.41 0.60 9.9 15.5 2.2 1 0.40 0.496 1.00 08:10 0.42 1.42 2.04 34.0 12:8 3.3 1	MDB	04/03/96		15.05				5.9				20 sec. purge, no water pulled.				
04/03/96 0.00 19:05 0.41 0.41 0.60 9:9 15.5 2.2 1 04/04/96 1.00 08:10 -0.04 0.96 1.38 23.0 13.7 3.0 1 04/04/96 1.00 19:10 0.42 1.42 2.04 34.0 12.8 3.3 1	200	2000										20 sec. purge, pulled very little				
04)04/96 1.00 08:10 -0.04 0.96 1.38 23.0 13.7 3.0 1 04/04/96 1.00 19:10 0.42 1.42 2.04 34.0 12.8 3.3 1	MPR-5	04/03/96		19:05		_						water.				
04/04/96 1.00 19:10 0.42 1.42 2.04 34.0 12.8 3.3	MPB-5	04/04/96		08:10								20 sec. purge, no water pulled.				
	MPB-5	04/04/96		19:10	0.42	-						20 sec. purge, no water pulled.				

EAKER AFB - SPILL SITE NO. 1 - INITIAL

Biodegradation Rate Calculations

calculated data enter data

Formula:

$$K_b = K_o \times 1/100\% \times A \times D_o \times C$$
 Where:

K_b = fuel biodegradation rate

 $K_o = O_2$ utilization rate (%/min.)

A = volume of air/kg soil

 $D_o = O_2$ density = 1340 mg/L C = Carbon/O₂ ratio for hexane mineralization = 1/3.5

Solving for 1 L of soil:

11.0	11.0	11.0	11.0
0.01851	0.02079	0.01838	0.01798
MPD-9	MPC-9	MPB-8.5	MPA-9

$$K_o = 0.01614$$

 $W = 11.0$

SILT, CLAY

Porosity:

Unit weight (dry):

Specific gravity:

Void ratio:

$$n = 0.30$$

 $d = G*^{0}w*(1-n) = 1.86$
 $e = n/7-n = 0.43$

g/cm³

2.65

Void volume:
$$V_{v} = n * 1 L = Deg.$$
 of saturation: $S_{r} = Gw/e = Volume of water: $V_{w} = S_{r} * V_{w} = Volume of air: $V_{w} = V_{w}$$$

Volume of air:

0.3	0.3	0.3	0.3
0.68	0.68	0.68	0.68
0.2	0.2	0.2	0.2
0.10	0.10	0.10	0.10

$= (M_6 * ^M \Lambda) + P_6$	$A = V_a/Bulk$ Density
Bulk density:	Air filled volume:

2.1	0.048	
2.1	0.048	
2.1	0.048	
2.1	0.048	

$$K_b = K_o * 1/100\% * A * D_o * C * 525,600 min/yr$$

ہ ہ ا

year

a/ Moisture: ^{b/} Assume:

For each monitoring point, the moisture value represents an average of three samples.

Soil properties are specified from Table 1.4. (Ref. Foundation

Engineering, Peck, Hanson, and Thornburn, John Wiley Press, 1974)

EAKER AFB - BOILDING 457 AKEA -TINTIAL

Biodegradation Rate Calculations

enter data calculated data

Formula:

 $K_b = K_o \times 1/100\% \times A \times D_o \times C$ Where:

 $K_b = \text{fuel biodegradation rate}$ $K_o = O_2 \text{ utilization rate (\%/min.)}$

A = volume of air/kg soil

 $D_o = O_2 \text{ density} = 1340 \text{ mg/L}$

 $C = Carbon/O_2$ ratio for hexane mineralization = 1/3.5

Solving for 1 L of soil:

Monitoring Point: Oxygen util. rate Moisture content ^{a/}

 $K_o = \frac{VW1}{0.04317}$ %/min. $W = \frac{17.7}{0.04317}$ %

MPB-5 MPC-4.5 0.05068 0.05212 0.05757 17.7 17.7

SILT, CLAY

SILT, CLAY

SILT, CLAY

Soil Type ^{b/}

SILT, CLAY

0.34 1.75 g/cm³ 0.52 2.65

 $= G^{*9}w^{*}(1-n) =$

Unit weight (dry):

Porosity:

Specific gravity:

Void ratio:

11 11

e = n/1 - n =

 0.34
 0.34
 0.34

 1.75
 1.75
 1.75

 0.52
 0.52
 0.52

 2.65
 2.65
 2.65

Void volume: Deg. of saturation: Volume of water:

Volume of air:

 $V_{v} = n * 1 L = 0.34$ liters $S_{r} = Gw/e = 0.9$ $V_{w} = S_{r} * V_{v} = 0.03$ liters $V_{a} = V_{v} - V_{w} = 0.03$ liters

 0.34
 0.34
 0.34

 0.9
 0.9
 0.9

 0.31
 0.31
 0.31

 0.03
 0.03
 0.03

Bulk density: Air filled volume:

 $^9d + (V_w * ^9w) =$ $A = V_a/Bulk Density$ $O = V_a/Bulk Density$ $O = V_a/Bulk Density$

 2.1
 2.1
 2.1

 0.014
 0.014
 0.014

, K

1216

mg TPH/ 1428 1468 kg soil/

1622

 $K_b = K_o * 1/100\% * A * D_o * C * 525,600 min/yr$

For each monitoring point, the moisture value represents an average of two samples.

year

Soil properties are specified from Table 1.4. (Ref. Foundation Engineering, Peck, Hanson, and Thornburn, John Wiley Press, 1974)

^{a/} Moisture: ^{b/} Assume:

EAKER AFB - UST 702 - INITIAL

Biodegradation Rate Calculations

enter data calculated data

Formula:

 $K_b = K_o \times 1/100\% \times A \times D_o \times C$ Where:

 K_b = fuel biodegradation rate $K_o = O_2$ utilization rate (%/min.)

A = volume of air/kg soil $D_0 = O_2$ density = 1340 mg/L

 $C = Carbon/O_2$ ratio for hexane mineralization = 1/3.5

Solving for 1 L of soil:

Monitoring Point: Oxygen util. rate Moisture content ^{a/}	K _o = w =	0.01110 10.2	%/min. %	MPB-5 0.00945 10.2
Soil Type ^{b/}		SILT, CLAY		SILT,CLAY
Porosity: Unit weight (dry): Void ratio: Specific gravity:	$n = $ $^{g}d = G^{*g}W^{*}(1-n) = $ $e = n/1-n = $ $G = $	0.30 1.86 0.43 2.65	g/cm³	0.30 1.86 0.43 2.65
Void volume: Deg. of saturation: Volume of water: Volume of air:	$V_{v} = n * 1 L = S_{r} = Gw/e = V_{w} = S_{r} * V_{v} = V_{a} = V_{v} - V_{w} = V_{a}$	0.3 0.63 0.19 0.11	liters liters	0.3 0.63 0.19 0.11
Bulk density: Air filled volume:	$^{g}d + (V_{w} *^{g}w) =$ A = V_{a} /Bulk Density	0.052	kg/L soil L air/kg soil	2.1 0.052
K _b = K _o * 1/100% * A * I	$K_b = D_o * C * 525,600 \text{ min/yr}$	1161	mg TPH/ kg soil/ year	989

^{a/} Moisture:

For each monitoring point, the moisture value represents an average of three samples.

^{b/}Assume: Soil properties are specified from Table 1.4. (Ref. Foundation

Engineering, Peck, Hanson, and Thornburn, John Wiley Press, 1974)

EAKER AFB - SPILL SITE 1

Steady-state Equation - Air Injection

Enter data

 $O \mu \ln (Rw / Ri)$ k =

Calculated data

H 34 Patm [1 - (Pw / Patm)2]

Where:

O = Volumetric flow rate of vent well

 $scfm x (30.48 cm/ft)^3 x (1 min/60 s) =$

cm³/s 1.55E + 04

 $\mu = \text{Viscosity of Air @ 18}^{\circ} \text{ C} =$

1.80E-04 g/cm s

Patm = Ambient pressure @

250 feet of elevation (use Excel table to get this number)

inches H2O x (3.61E-2 psia/in. H2O) =402

14.512

psia

psia x $(6.89476E4 \text{ g/cm s}^2)/\text{psia} =$ 14.512

1.00E + 06

g/cm s²

Rw = Radius of Vent Well

inches x 2.54 cm/in = 2

5.08

cm

H = Depth of Screen (length of screened interval)

10

feet x 30.48 cm/ft =

305

cm

Ri = Maximum Radius of Venting Influence

33

feet x 30.48 cm/ft =

1006

cm

psia

psia

Pw = Absolute Pressure at Vent Well

41

inches H2O x (3.61E-2 psia/in. H2O) =

1.480

1.480

psia +

14.512 psia =

k =

15.992

15.992

psia x $(6.89476E4 \text{ g/cm s}^2)/\text{psia} =$

1.10E + 06

g/cm s²

7.196E-08

cm²

7.200E-08

 $cm^2 x (1 m/100 cm)^2 =$

7.200E-12

 m^2

7.200E-12

 $m^2 \times 1 \text{ darcy/(9.870E-13 m}^2) =$

7.29

darcys

Eaker AFB

ipilisité No. 1	MF	A-9	М	°R-8,5	М	PC-9	
Air Permeability T	est - Da	ta Analysis	(cont.)				
Enter radial distances	r= 10	0.2 (ft)	r= 2	0.2 (ft)	f= =	32.8 (ft)	
of monitoring points	(min)	(in H2O)	(min)	(in H2O)	(min)	(in H2O)	
ſ	0	0	0	0	0	0 1	1
2) Enter measured times	0.5	0.3	0.5	i	5	0.18	1
and gauge vacuums	1	0.9	1	0	6	0.19	1
	1.5	1.4	1.5	0.13	7	0.50	
3	2	1.7	2	0.26	8	0.67	
3) Enter (optional):	3	2.3	3	0.77	9	0.84	
a) flowrate	4.5	3.2	4	1.00	10	1.0	
40 (SCFM)	5	3.5	5	1.45	12	1.25	
b) screened interval	6	3.7	6	1.62	14	1.3	
thickness	7	3.95	7	1.80	16	1.45	1
5.5 (ft)	8	4.1 T	8	2.00	18	1.5	
	9	4.3	9	2.15	20	2.0	
	10	4.4	10	2.22	24	2.1	
	13	4.9	11	2.40	26	2.1	
	15	5.0	13	2.80	29	2.1	
	17	5.1	15	3.15	32	2.5	
	19	5.3	17	3.35			4
	21	5.4	19	3.40			
	23	5.6	21	3.65			
	25	5.6	23	3.75		1	
	27	5.75	25	3.8		1	1
	30	5.85	28	4.2			
	33	6	31	4.35			
	38	6.1	39	4.35			
	43	6.2	44	4.25			
	48	6.2	49	4.35			
	53	6.3	54	4.60			
	61	6.35	62	4.65			
	73	6.35	73	4.9			
		1		+		1	1
	G	ear	G	ear		elear	
k			k= 54.76 k= 12.56	9308 darcy (A) 1277 darcy (B)	k= 53.190 k= 8.623		
k	= 8.96726		Return		olamation & Sta		AP8

EAKER AFB - Bldg 457 Area Steady-state Equation - Air Injection

Enter data

 $k = \frac{Q \mu \ln (Rw/Ri)}{}$

 $H \frac{3}{4} Patm [1 - (Pw / Patm)^2]$

Calculated data

Where:

Q = Volumetric flow rate of vent well

11.5 scfm x (30.48 cm/ft) 3 x (1 min/60 s) =

5.43E+03 cm^3/s

 μ = Viscosity of Air @ 18° C =

1.80E-04 g/cm s

Patm = Ambient pressure @

250 feet of elevation (use Excel table to get this number)

402 inches H2O x (3.61E-2 psia/in. H2O) =

14.512 psia

14.512 psia x $(6.89476E4 \text{ g/cm s}^2)/\text{psia} =$

1.00E+06 g/cm s²

Rw = Radius of Vent Well

1 inches x 2.54 cm/in =

2.54

H = Depth of Screen (length of exposed screened interval)

5.5 feet x 30.48 cm/ft =

168 cm

cm

Ri = Maximum Radius of Venting Influence

25 feet x 30.48 cm/ft =

762 cm

Pw = Absolute Pressure at Vent Well

26 inches H2O x (3.61E-2 psia/in. H2O) =

0.939 psia

0.939 psia +

14.512 psia =

15.451 psia

15.451 psia x $(6.89476E4 \text{ g/cm s}^2)/\text{psia} =$

1.07E+06

g/cm s²

k =

7.918E-08

cm²

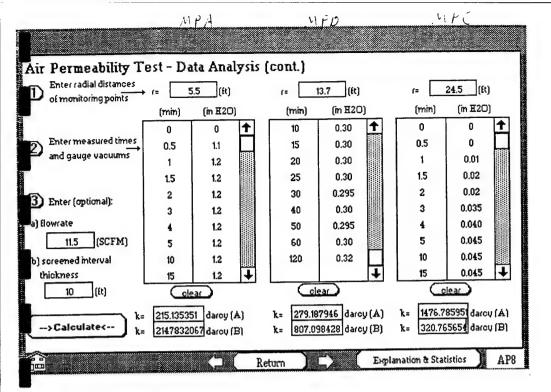
7.920E-08 cm² x $(1 \text{ m}/100 \text{ cm})^2 =$

7.900E-12

7.900E-12 $m^2 \times 1 \text{ darcy}/(9.870\text{E}-13 \text{ m}^2) =$

darcys

 m^2



Eaher B/457 Area 4/2/96

EAKER AFB - UST 702

Steady-state Equation - Air Injection

Enter data

 $k = \frac{Q \mu \ln (Rw / Ri)}{H \frac{3}{4} Patm [1 - (Pw / Patm)^{2}]}$

Calculated data

Where:

O = Volumetric flow rate of vent well

11.1 scfm x (30.48 cm/ft) 3 x (1 min/60 s) =

5.24E+03 cm^3/s

 μ = Viscosity of Air @ 18° C =

1.80E-04 g/cm s

Patm = Ambient pressure @

250 feet of elevation (use Excel table to get this number)

402 inches H2O x (3.61E-2 psia/in. H2O) =

14.512 psia

14.512 psia x $(6.89476E4 \text{ g/cm s}^2)/\text{psia} =$

1.00E+06 g/cm s²

Rw = Radius of Vent Well

1 inches x 2.54 cm/in =

2.54 cm

H = Depth of Screen (length of exposed screened interval)

3 feet x 30.48 cm/ft =

91 cm

Ri = Maximum Radius of Venting Influence

20 feet x 30.48 cm/ft =

610 cm

Pw = Absolute Pressure at Vent Well

35 inches H2O x (3.61E-2 psia/in. H2O) =

1.264 psia

psia

cm²

1.264 psia +

14.512

15.776

15.776 psia x (6.89476E4 g/cm s²)/psia =

1.09E+06 g/cm s²

k =

psia =

9.897E-08

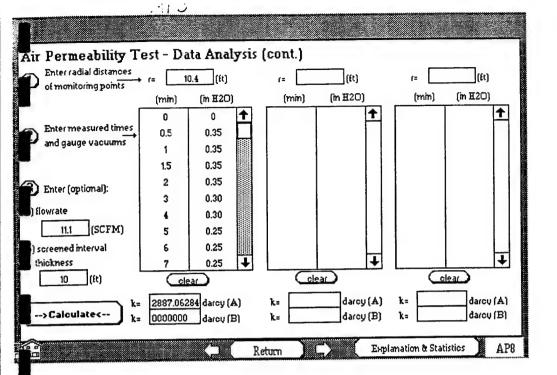
9.900E-08 cm² x (1 m/100 cm)² =

9.900E-12 m²

9.900E-12 $m^2 \times 1 \text{ darcy}/(9.870\text{E}-13 \text{ m}^2) =$

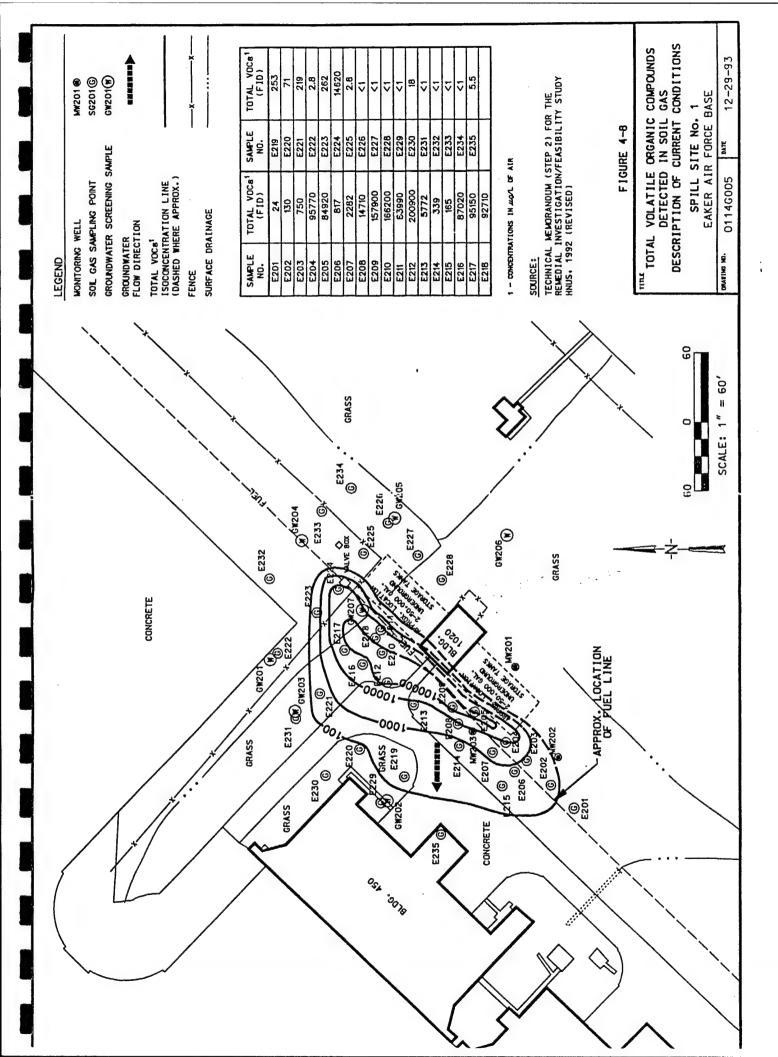
10.03

darcys



Eaker UST 702 4/2/46

APPENDIX B SOIL GAS SURVEY SUMMARY



SOIL GAS SURVEY
EAKER AIR FORCE BASE
BLYTHEVILLE, ARKANSAS

PREPARED FOR

HALLIBURTON NUS ENVIRONMENTAL CORPORATION

JACKSON PLAZA, C-200 800 OAK RIDGE TURNPIKE OAK RIDGE, TENNESSEE 37830

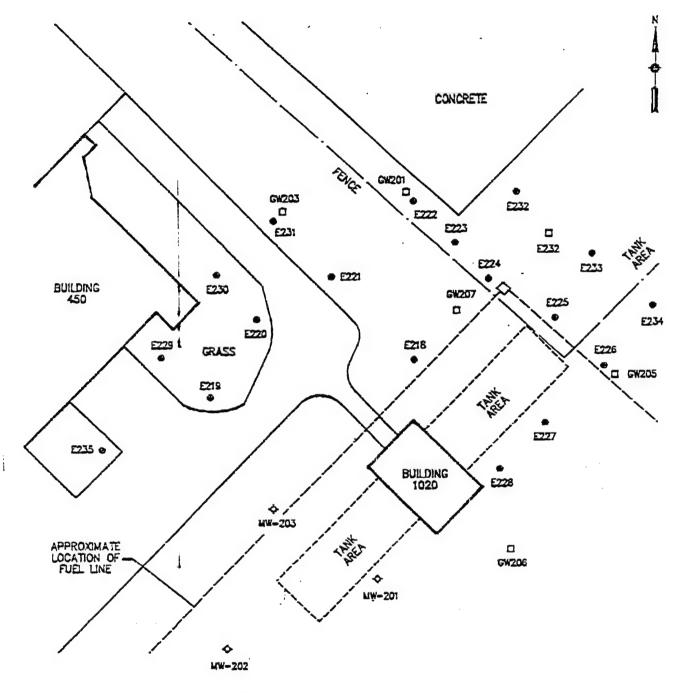
PREPARED BY

TARGET ENVIRONMENTAL SERVICES, INC.
9180 RUMSEY ROAD
COLUMBIA, MARYLAND 21045

(301) 992-6622

JANUARY 1992







- SOIL GAS SAMPLE LOCATION
- GROUNDWATER SAMPLE LOCATION
- O MONITORING WELL

ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

FIGURE 2. Sample Locations

SPILL SITE #1
REMEDIAL INVESTIGATION REPORT
EAKER AIR FORCE BASE
BLYTHEVILLE, ARKANSAS

Field Procedures

Soil gas samples were collected at a total of 63 locations at Proposed Sample E101 was not collected due to the presence of water. To collect the samples, a van-mounted hydraulic probe was used to advance connected 3 foot sections of 1 inch diameter threaded steel casing down to the sampling depth. Because of limited soil vapor in the very tight and moist clay soils, the probe was advanced to a depth of 8 to 9 feet and then drawn up to approximately 6 feet in order to obtain sufficient vapor for a sample at several locations. Sample E315 was collected at a depth of 5 feet from a 6 foot hole. The entire sampling system was purged with ambient air drawn through an organic vapor filter A teflon line was inserted into the casing to the cartridge. bottom of the hole, and the bottom-hole line perforations were isolated from the up-hole annulus by an inflatable packer. sample of in-situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure (15 The self-sealing vial was detached from the sampling psiq). system, packaged, labeled, and stored for laboratory analysis.

Prior to the day's field activities all sampling equipment and probes were decontaminated by washing with soapy mater and rinsing thoroughly. Internal surfaces were flushed dry using prepurified nitrogen or filtered ambient air, and external surfaces were wiped clean using clean paper towels.

rield control samples were collected at the beginning and end of each day's field activities and after completion of sampling in each area. These QA/QC samples were obtained by filtering ambient air through a dust and organic vapor filter cartridge and collecting in the same manner as described above.

Laboratory Procedures

All of the samples collected during the field phase of the survey were analyzed according to EPA Method 602 (modified) on a gas chromatograph equipped with a flame ionization detector (GC/FID), but using direct injection instead of purge and trap. Analytes selected for standardization were:

benzene
toluene
ethylbenzene
meta- and para- xylene
ortho-xylene

These compounds were chosen because of their utility in evaluating the presence of petroleum products such as fuels, lubricating oils, and non-halogenated solvents.

samples E501-E520, from the waste oil UST area, were also analyzed according to EPA Method 601 on a gas chromatograph equipped with an electron capture detector (ECD), but using direct injection instead of purge and trap. Specific analytes standardized for the ECD analysis were:

1,1-dichloroethene (11DCE)
methylene chloride (CH₂Cl₂)
trans-1,2-dichloroethene (t12DCE)
chloroform (CHCl₃)
1,1-dichloroethane (11DCA)
carbon tetrachloride (CCl₄)
cis-1,2-dichloroethene (c12DCE)
1,1,1-trichloroethene (111TCA)
trichloroethene (TCE)
1,1,2-trichloroethane (112TCA)
tetrachloroethene (PCE)

The chlorinated hydrocarbons in this suite were chosen because of their common usage in industrial solvents, and/or their degradational relationship to commonly used compounds.

The analytical equipment was calibrated using an instrumentresponse curve and injection of known concentrations of the above standards. Retention times of the standards were used to identify the peaks in the chromatograms of the field samples, and their response factors were used to calculate the analyte concentrations.

Total FID Volatiles values were generated by summing the areas of all integrated chromatogram peaks and calculated using the instrument response factor for toluene. Injection peaks, which also contain the light hydrocarbon methane, were excluded to avoid the skewing of Total FID Volatiles values due to injection disturbances and biogenic methane. For samples with low hydrocarbon concentrations, the calculated Total FID Volatiles concentration is occasionally lower than the sum of the individual analytes. This is because the response factor used for the Total FID Volatiles calculation is a constant, whereas the individual analyte response factors vary with concentration. It is important to understand that the Total FID Volatiles levels reported are relative, not absolute, values.

The tabulated results of the laboratory analysis of the soil gas samples are reported in micrograms per liter ($\mu g/l$) in Tables 1 and 2. Although "micrograms per liter" is equivalent to "parts per billion (v/v)" in water analyses, they are not equivalent in gas analyses, due to the difference in the mass of equal volumes of water and gas matrices. The xylenes concentrations reported in Table 1 are the sum of the m- and p-xylene and o-xylene concentrations for each sample.

For QA/QC purposes, a duplicate analysis was performed on every tenth field sample. Laboratory blanks of carrier gas were also analyzed after every tenth field sample.

TABLE 1

ANALYTE CONCENTRATIONS VIA GC/FID (Ug/L)

	BENZEVE	TOLUME	ETHYL-	XYLDIES	TOTAL FID VOLATILES
SUPLE	BELLERE				
E201	1.6	<1.0	<1.0	1.8	24 -
E505	4.8	<1.0	1.4 10	4.1 12	130 750
E203	7.3	<1.0 54	327	638	95,770
E204	515 912	82	142	. 612	84,920
E205	3.4	4.0	5.5	25	817
E207	12	1.1	20	22 25	2,282
E208	242	41	64	·158	14,710
E209	3,063	59	261	597	157,900
E210	1,245	47	292	706	166,200
E211	785	48	481	\$47 675	83,990
E212	2,734	435	22 6 7 6	635 270	200,900 5,772
E213 E214	117 5.9	141 2.4	4.2	, 13	339
£215	1.7	<1.0	1.9	4.4	165
E216	650	43	364	741	87,020
E217	552	ವ .	143	352	95,150
E301	70	4.0	49	135	2,243
E302	106	1.5	- 54	120	2,812
E303	58	1.9	75 184	191 510	2,635
E304 E305	318 164	13 24	149	. 353	11,470 16,810
E306	4.0	<1.0	4.0	4.7	182
E307	39	<1.0	22	94	1,380
F208.	29	4.0	28	69	1,030
E309	7.4	20	60	107	4,458
E310	87	3.3	62	204	3,290
E311	68	4.0	57	190	1,912
E312	99	<1.0	60 125	201 542	2,336
5314 5314	144 101	7.9 20	312	712	9,371 22,640
ES 15	23	₹.0	28	132	2,283
E316	116	1.6	76	325	4,205
E317	1-6	<1.0	1_0	<1.0	48
E318	58	7.6	89	321	2,818
E319	127 1,547	3.2	108 509	395	5,302
5320 5321	1,547	103 9.1	113	1,582 507	89,980 12,300
ESZZ	98	4.0	55	114	2,288
E323	43	47	48	298	3,821
E324	273	. 44	251	1,132	35,030
E325	4.4	₹.0	4.5	15	148
E326	<1.0	<1.0	4.0	<1_0	6.4
E501	94 .	. 22	- 210	551	17,740
E502 E503	24 82	9.7 167	134 77	332 134	8,131
E504	17	5.2	41	73	28,560 9,213
E505	3.9	4.0	13	49 .	757
E506	98	8.7	147	351	7,608
£\$07	115	8.9	134	310	10,960
E508	153	5.3	88	208	9,408
E509 E510	252	37	294	560	41,990
E511	1,156	110 1.8	4ප 11	707 16	168,830
E512	4.0	<1.0 <1.0	<1.0	2.5	635 7.5
ES13	33	63	150	1,055	14,890
E514	1.1	1.3	4.3	22	508
ES15	51	4_4	80	125	4,954
E516	474	716	576	426	99,610
E517	<1.0	<1.0	9.5	11	331

¹ CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHRIDWITOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLLIENE

, ANALYTE CONCENTRATIONS VIA GC/FID (UE/L)

SUPLE	REVIZENCE	TOLUENE	ETHTL- BENZEVE	-KYLEKES	TOTAL FID
•			**	4.5	4 4==
E518	<1.0	1.6	35	65	1,105
E519	8.2	3.0	25	43	2,017
E520	<1.0	⊲.0	1.1	2.1	31
FIELD CONTRO	X SAMPLES				
E231	<1.0	<1.0	<1.0	2.2	9.4
E232	<1.0	<1.0	<1.0	<1.0	<1.0
£331	<1.0	<1.0	<1.0	<1.0	<1.0
E332	<1.0	41.0	<1.0	<1.0	<1.0
E333	<1.0	41.0	<1.0	<1.0	<1.0
E334	<1.0	<1.0	<1.0	<1.0	<1.0
E531	4.0	<1.0	<1.0	<1.0	<1.0
E532	<1.0	<1.0	1.1	2.5	17
E333	<1.0	4.0	<1.0	<1.0	<1.8
E534	<1.0	<1.0	<1.0	<1.0	4.0
	UPLICATE AVALTSES				4,00
	# 9/E	- 47	~~	70.4	444 888
E210 E210R	1,245 1,230	41	292 282	706 . 680	166,200 158,400
22100	1,650	٠.			136,400
2308	29	<1.0	28	69	1,000
E303R	29	<1.0	27	66	974
E318	58	1.6	89	321	2,818
E3182	58	1.6	90	313	2,806
ESSZ	<1.0	<1_0	<1.0	<1.0	<1.0
E332R	<1.0	<1.0	<1.0	<1.0	<1.0
ESGE	153	5.3	88	208	9,408
E508R	151	5.2	85	201	9,330
E\$18	<1.0	1.6	35	AF.	4 405
ESTER	<1.0	1.4	31	65 58	1,105 9 85
LABORATORY BI				-	,,,,
BSNLE-1	<1.0	4.0	<1.0	<1.0	<1.0
BSMUE-2	<1.0	<1.0	<1.0	<1.0	<1.0
BSNUE-3	<1.0	<1.0	<1.0	<1.0	<1.0
BSME-4	<1.0	<1.0	· <1_0	<1.0	<1_0
BSMJE-5	<1.0	4.0	<1.0	<1.0	<1.0
BSME-6	<1.0	<1.0	<1.0	<1.0	<1.0

¹ CALCULATED USING THE SUN OF THE AREAS OF ALL INTEGRATED CHRONATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLLIENE

TABLE 2 AMALYTE CONCENTRATIONS VIA GC/ECO (MO/L)

	445.00	er el	172005	TIDEA	c120CE	DICL3	111TCA	Œ[,	TE:	112TCA	PCE
SUPLE	11DCE		LICALE	11000					•		
			<1.8	<1.0	<1.0	€0.10	€.10	40.0 5	€0.10	<0.10	<0.05
E501	<1.0	4.0	<1.0	<1.0	<1.0	€.10	<0.10	<0.05	<0.10	<0.10	<0.05
E502	<1.0	4.0	<1.0	<1.0	<1.0	40.10	40-10	<0.05	<0.10	Ø.10	<0.05
E503	<1.0	<1.0	<1.0	<1.0	4.0	€.10	40.10	€0.05	<0.10	€.10	<0.05
E504	4.0	<1.0	<1.0	<1.0	<1.0	Ø.10	40.10	<0.05	€0.10	<0.10	€.05
E505	<1.0	41.0		<1.0	<1.0	€.10	€0.10	40.05	40.10	<0.10	<0.05
E506	<1.0	<1.0	. <1_0 <1.0	<1.0	<1.0	40.10	€0.10	40.05	<0.10	<0.10	<0.05
£507	<1.0	≤1.0		<1.0	41.0	40.10	€.10	40.05	€2.10	<0.10	<0.05
E508	<1.0	<1.0	ଧ.0 ପ.0	<1.0	<1.0	40.10	€.10	40.05	<0.10	<0.10	0.07
E509	<1.0	<1.0		<1.0	14	€.10	€0.10	40.05	40.10	<0.10	0.15
E510	4.0	<1.0	<1.0	<1.0	<1.0	€0,10	€0.10	40.05	40.10	<0.10	<0.05
E511	<1.0	<1.0	<1.0 <1.0	<1.0	<1.0	€0.10	€.10	41.05	€0.10	<0.10	<0.05
E512	<1_0	<1.0		<1.0	<1.0	Ø.10	€.10	40.05	€.10	40.10	<0.05
E513	<1.0	<1.0	<1.0 <1.0	<1.0	<1.0	4.10	€0,10	40.05	€0.10	<0.10	<0.05
E514	<1.0	<1.0		<1.0	<1.0	Ø.10	€.18	40.05	€0.10	<0.10	<0.05
E515	<1.0	<7.0	<1.0 <1.0	₹1.0	11	40.10	40,10	4.35	0.10	<0.10	40.05
E516	4.0	<1.0		<1.0	<1.0	₫.10	₩.10	40.05	€.10	40.10	<0.05
E517	<1.0	<1.0	<1.0	<1.0	<1.0	40.10	40.10	40.05	40.10	€0.10	€0.05
E518	4.0	<1.0	<1.0	<1.0	<1.0	40.10	€.10	4.05	€.10	₹.10	40.05
E519	<1.0	41.0	4.0		<1.0	40.10	€0.10	40.05	€0.10	.O.10	40.05
E520	<1.0	<1_0	<1.0	<1.0	~1.0	4. 10	- 10	4.05	4.10	. •	~
FIELD C	INTROL SA	TES.									
			<1.0	<1.0	<1.0	<0.10	<0.10	<0.05	<0.10	<0.10	<0.05
E531	<7.0	<1.0 <1.0	<1.0	<1.0	<1.0	€0.10	€0.10	40.05	40.10	40.10	<0.05
E532 ·	<1.0	<1.0	<1.0	<1.0	<1.0	€.10	€.10	40.05	€0.10	€0_10	<0.05
E533	<1.0	<1.0	<1_0	<1.0	<1.0	4.10	40.10	40.05	40.10	€0.10	<0.05
E534	<1.0	<1-0	<1-0	<1.0	~1.0	40.10	40.10	٠	4	4	2.05
LADODATO		CATE ANALY	cee								
CABCACATO	<u> </u>	CAIL ALLE	3.2								
E508	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10	<0.05	<0_10	<0.10	€.05
£508R	4.0	<1.0	<1.0	<1.0	<1.0	40.10	<0.10	€0.05	€.10	€0.10	<0.05
			*****			••••		- •			
E\$18	<1.0	<1.0	0-7>	<1.0	<1.0	40.10	40.10	⋖0.05	⋖ 0.10	<0.10	<0.05
E518R	<1.0	<1.0	<1.0	<1.0	<7.0	40.10	40.10	<0.05	<0.10	<0.10	<0.05
->	-,	-,									
LAZORATO	RY BLANK	TS .									
BSNUE-1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	€.10	<0.05	€0.10	<0.10	40.05
BSNUE-Z	<1.0	<1.0	<1.0	<1.0	<1.0	€0.10	<0.10	40.05	40.10	<0.10	<0.05

1,1-dichloroethene 110CE = t120CE = trans-1,2-dichloroethene cis-1,2-dichloroethene 1,1,1-trichloroethene = 300513 111YEA = TŒ trichloroethene PCE = tetrachloroethene

TIDEA methylene chloride 1,1-dichloroethane chloroform

CCL = carbon tetrachloride 1,1,2-trichloroethane

ANALYTES DETECTED IN GROUNDWATER. SPILL SITE NO. 1 (PAGE TWO) TABLE 4-8

3	_	_	-	,		-	_	_	, ,,,	7	-	_	-	_	-	,
		E02-GW-	MW203C	12/14/91	Mary Market Comment	The section of the se			680	21	13	714	SECTION SECTION	0.7	Martin Martin San Control of the Con	999
	MW203	E02-GW-	MW203B	7/17/91	To the state of th	WHITE STATES AND ADDRESS OF THE PARTY OF THE			210	15		225	BATCH STATISTICS OF STATIST		THE STATE OF THE PARTY OF THE	504
		BL02-GW-	MW203A	6/9/38	3	Machanica (Artista) Investo			1500	660	1210	3260	noted Professional Section of the second for the second section of the second section of the second second second second section of the second	6.9	ACTION INC. TO A CONTROL OF THE CONTROL OF THE STATE OF T	NA
A		E02-GW.	MW202C	12/14/91		280.)	20						Reactions (\$5 campages and		Market and the region of 1725.	310 J
	MW202	E02-GW-	MW202B	7/17/91									PATERNATURE OF THE PARTY STATES		W. P. S. C. C. C. S. C. S. C. C. C. C. C. C. C. C. C. C. C. C. C.	324
		BL02-GW-	MW202A	89/8/9					4				ESCENSION CONTRACTOR SECTIONS		WOUTH TOP WORTH SEP WIS 20	NA
	Sampla Location	Sample Number		Date Sampled	VOCe (ug/l.)	Acetone	2.Butanons	Tolusna	Bonzene	Ethylbenzena	Total Xylenes		MARKET WATER		3	Total Dissolved Solids (mg/L)

Footnotes:

VOCs - Volatile Organic Compounds

Total BTEX - Sum total of Benzens, Toluene, Ethylbenzene, and Total Xylene concentrations

TPH · Total Patroleum Hydrocarbons

J - Concentration is estimated

Biank Space - Compound not detected above method quantitation limit

NA - Compound not analyzed

D qualifier in Sample Number - Duplicate sample

on institution tables, a list of all analyzed compounds their quantitation limits, Note: 1.) Only compounds detected at or above method quantitation limits are presented and their analytical methos references may be found in Appendix L.

2.) Analytical Methods:

VOCs - 1988 samples - EPA CLP, 1987b; 1991 samples EPA CLP, 1988a TPHs - EPA 418.1 for both 1988 and 1991 samples

APPENDIX C O&M CHECKLIST

DATA COLLECTION SHEET REGENERATIVE BLOWER SYSTEM SITE EAKER AFB, ARKANSAS

		 	 	 	 	 	 —	
Checked by (initials)								
Comments								
Power Usage (kw-hr)								
Outlet Pressure (inches H ₂ O)								
Outlet Temperature (° F)								
Inlet Vacuum (inches H ₂ O)								
Blower Functioning Upon Arrival? (Y/N)								
Time								
Date								